DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION SPECIFICATION

SPECIFICATION FOR ARTS IIIA
IMPROVEMENTS TO THE MODULARLY
EXPANDABLE ARTS III BEACON TRACKING LEVEL SYSTEM

1. INTRODUCTION - This system specification describes
the requirements for enhancing the existing Modular
Automated Radar Terminal System (ARTS). This
enhancement is an initial set of improvements which
will meet immediate terminal air traffic control needs.
It also affords the broader automation base required
for the addition of automation enhancements necessary
to meet future operational requirements.

1.1 Scope - Existing (basic) ARTS III systems are
essentially beacon tracking level systems, i.e., they
process and track secondary radar (beacon) data derived
from up to two ASR systems. These data are processed,
tracked and displayed on a CRT in association with
automatically and semiautomatically displayed symbology
and alphanumerics. The latter provides aircraft
identification, Mode C derived altitude, target
velocity and/or radar beacon code readout to the
operator (Air Traffic Controller). The system permits
the operator to enter data and selectively display,
alter or delete data consistent with operational needs.
Normal primary as well as secondary radar presentations
are displayed concurrently with the symbolic and
alphanumeric data. The system also provides the
capability of data/message interchange with ARTCC
computer systems. Basic ARTS III systems are equipped
with a magnetic tape subsystem used principally for
loading the software program and a teletypewriter
subsystem primarily used for on-line printing of system
status messages...

The purpose of this enhancement is to elevate a number
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2. APPLICABLE DOCUMENTS

2.1 Government Documents - The following documents, including all revisions and amendments, in effect on the date of request for proposal, form a part of this document and are applicable to the extent specified herein.

2.1.1 FAA Specifications -

FAA-TD/S-120-801A	Specification for Modularly Expandable ARTS III (TRACON "C") Beacon Tracking Level System and Spec Changes 1, 2, 3, 4, 5, and 6
FAA-G-1210	Identification & Cataloging of Replaceable Parts
FAA-C-1217	Electrical Work, Interior
FAA-G-2100/*	Part 1, General Requirements for all Equipment
FAA-G-2100/1	Supplement 1c
FAA-G-2100/1	Amendment 2
FAA-G-2100/2	Requirements for Equipments Employing Electron Tubes
FAA-G-2100/3	Requirements for Equipments Employing Semiconductors
FAA-G-2100/4	Requirements for Equipment Employing Printed Wiring

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*Specifications FAA-G-2100/1, Supplement 1c, Amendment 3, FAA-G-2100/2, FAA-G-2100/3, FAA-G-2100/4 and FAA-G-2100/5 are referred to hereafter as FAA-G-2100.

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NAS-MD-604	Introduction to Specification Series
NAS-MD-605	Executive Control
NAS-MD-606	Beacon Message Processing
NAS-MD-607	Beacon Target Processing (Tracking)
NAS-MD-608	Keyboard Input Processing
NAS-MD-609	Display Output Processing
NAS-MD-610	Interfacility Data Transfer
NAS-MD-611	Bulk Store Flight Plans
NAS-MD-612	ASR-37 Error and Status Messages
NAS-MD-613	Adaptation
AO-6030.36A	Maintenance Logs

2.1.4 FAA Instruction Books -

2.1.4.1 Beacon -

(a) Air Traffic Control Beacon Ground Station, Model ATCBI-3, Transmitter Site Equipment Group

(b) Instruction Book Addendum for Air Traffic Control Beacon Ground Station, Model ATCBI-3B

(c) Air Traffic Control Beacon Ground Station, Model ATCBI-3, Indicator Site Equipment Group

(d) Air Traffic Control Beacon Station, Model ATCBI-2, Indicator Site Equipment Group

(e) Beacon Video Defruiting Equipment (Storage Tube) Type FA-7281

(f)   Radar Beacon Test Set, Type FA-7270 and Type 7274

(g)   Air Traffic Control Beacon Station ATCBI-4, TI 6360.12

(h)   Interference Blanker MX-8737/UPX. Technical Manual TM/NAVELEX 0967-426-5010

(i)   AICRBS I/R site test set, FA-8169, TI 6360.11A

2.1.4.2 FAA Directives -

AF P 6350   Radar Microwave Link - RML

AF P 6360.1   ATCBI - Beacon

AF P 6310   ASR - Radar

2.1.4.3 Microwave Link Equipment -

(a)   Radar Microwave Link System, RML-2

(b)   Radar Microwave Link System, RML-3

(c)   Radar Microwave Link System, RML-4

(d)   Radar Microwave Link System, RML-1A

(e)   Radar Microwave System, RML-5

(f)   Radar Microwave System, RML-6 TI 6350.1A

2.1.4.4 Airport Surveillance Radar -

(a)   Airport Surveillance Radar, ASR-3

(b)   Equipment Modification Set for Airport Surveillance Radar, Model ASR-3 i

(c)   Airport- Surveillance Radar Antenna System ASR-1, -2, -3, Type FA-5144

(d)   Airport Surveillance Radar, ASR-3B

    (f)   Radar Beacon Test Set, Type FA-7270 and Type 7274

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    (d)   Airport Surveillance Radar, ASR-3B

MIL-STD-785   Requirements for Reliability
                     Program

2.2 ARTS III Enhancement Documents - The following
documents contain design data and information
representing the initial design approach for the
Package I improvements. This design approach, both
hardware and software, shall be used unless it is
proved by the contractor that the design approach
cannot meet the requirements set forth in this
specification.

(a)   Support Software Users' Guide, PX-6196

(b)   IOP Multiprocessing Modification Design Data,
      PX-6361

(c)   Design Specification for Display Buffer
      Memory Module, PX-7978.

(d)   Design Specification for Data Recording and
      Analysis System, PX-10091.

(e)   Design Specification for Augmented
      Radar/Beacon Tracking Level System, PX-7981.

(f)   Fail Soft Multiprocessor Executive Program
      Design Data, PX-7982.

(g)   Multiprocessor Executive Model Support,
      PX-10001

(h)   Off-line Diagnostic Design Data, PX-10004.

2.3 Precedence of Documents - When the requirements of
the contract schedule, this document, or subsidiary
applicable documents are in conflict, the following
precedence shall apply. The contract schedule shall
have precedence over all other documents. This
document shall have precedence over all subsidiary
applicable documents referenced herein.

2.3.1 Sources of FAA Documents - Copies of this
specification and of the applicable FAA Specification
Drawings may be obtained from the Federal Aviation

Administration, Washington, D. C., 20591, attention:
Contracting Officer. Requests shall fully identify
material desired, i.e., specification numbers, dates,
amendment numbers, complete drawing numbers; also,
requests should identify the invitation for bids,
request for proposals, or the contract involved or
other use to be made of the material requested.

2.3.2 Sources of Military Documents - Single copies of
military specifications may be obtained from the
Federal Aviation Administration, Washington, D. C.,
20591, attention: Contracting Officer; mail requests
should cite the invitation for bids, request for
proposals, or contract for which the specifications are
needed; mail requests, if found acceptable, will be
forwarded to a military supply depot for filling, hence
ample time should be allowed.

2.3.3 Sources of Other Documents - Information on
obtaining copies of Federal Specifications and
Standards may be obtained from the General Services
Administration Offices in Washington, D. C., Seattle,
San Francisco, Kansas City, Missouri, Chicago, Atlanta,
New York, Boston, Dallas and Los Angeles.

3. SYSTEM REQUIREMENTS

3.1 System Overview - This specification sets forth
the minimum requirements for initial improvement of the
existing FAA ARTS III systems. These requirements
include the system hardware, software, operation,
testing, reliability, installation and maintainability
functions necessary to enhance ARTS III Beacon Tracking
Level (BTL) systems to Radar Tracking and Beacon
Tracking (RT & BTL) systems and to provide Continuous
Data Recording (CDR) MSAW and Ancilliary Function
Capabilities. The system shall provide broadband video
on display consoles together with high quality symbolic
and alphanumeric characters. These are **used** for
displaying data in tabular lists and for data tags
which are associated with displayed aircraft position
symbols. Alphanumeric data tags shall be capable of
displaying up to three lines of at least seven
characters each.

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3. SYSTEM REQUIREMENTS

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recording capabilities. A **failsoft** capability shall be afforded by the provision of at least three operational levels.

3.2 Equipment and Services to be Furnished

3.2.1 Equipment and Services to be Provided by the Contractor - The contractor shall provide the services and materials necessary to design, fabricate, modify, test, install and integrate the ARTS **IIIA** system as required by this specification. These shall be provided in quantities and at the times specified by the contract. The work to be performed shall include modifications, installation and checkout of existing Government Furnished Equipment **(GFE)** as a part of the overall contractor system installation, integration and checkout efforts. The work shall also include equipment unit and subsystem interconnections, testing and demonstration of the ability of the integrated system to meet specified system performance requirements. The work shall be planned so as to assure efficient integration with the existing ARTS III system. On-site work shall be scheduled and conducted so as to impose negligible impact on ongoing operational activities. All installation and checkout work shall be accomplished in this manner and the completed system shall become a part of the existing terminal air traffic control facility. In addition, the contractor shall provide all necessary services and material to prepare, reproduce and provide reports, computer programs and documentation as specified herein. Any feature or item necessary for proper operation in accordance with the requirements of the contract shall be incorporated even though that item or feature may not be specifically described herein.

3.2.1.1 Major Contractor Furnished Services and Equipment - All equipment and services shall be delivered and installed at the locations specified by the Government. All facilities, parts and hardware, including system/subsystem grounding plates, receptacles, connectors, cabling, wiring, adapters, and outlets, except **GFE** facilities specified in **3.2.2,** shall be provided to enable the components of each system to be assembled, interconnected and installed as

required by these specifications. The major items of equipment and services to be furnished are:

(a) Expansion of existing ARTS III data processing subsystems by the addition and modification of equipment including IOPs and memory modules (MM) and if required centralized memory access (CMA) in quantities ` adequate to support the added system performance requirements specified herein.

(b) Radar Data Acquisition Subsystems

(c) Added Beacon Data Acquisition Subsystems

(d) Peripheral Switch Module

(e) Continuous Data Recording and Medium Speed Printout Equipment

(f) Added and Modified Operational Program and Support Software

(g) Module and System Testing

(h) Special Tools and Test Equipment

(i) Cables, bridging and isolation equipment necessary for interconnecting existing equipment with the new equipment. Installation shall be accomplished between a GFE interface unit (Demarcation Junction Box) and the new equipment. All wiring'shall meet FAA-E-1217C sppcification requirements.

(j) Recommended size(s) of circuit breakers, primary power requirements and duct work to be furnished and installed by the Government. The contractor shall be responsible for the design of the grounding system for each field installation.

(k) All required AC power duct, conduit, or other appropriate cable support and power cable between the GFE power panel and the

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      be furnished and installed by the Government.
      The contractor shall be responsible for the
      design of the grounding system for each field
      installation.

(k)   All required AC power duct, conduit, or other
      appropriate cable support and power cable
      between the GFE power panel and the

contractor

(e)   All modems required for interfacility data
      transfer

(f)   Cable ladder, duct or other appropriate cable
      support between the Demarcation Junction Box
      and the contractor provided equipment
      cabinets

(g)   All grounding wires from existing signal
      reference plates to all contractor and GFE
      equipments as necessary to meet the
      requirements of the grounding system. The
      grounding system shall be installed in
      accordance with the design supplied by the
      contractor and as shown in the approved
      Installation and Cutover Plan provided by the
      contractor

(h)   All operational and support software
      associated with the current ARTS III Beacon
      Tracking Level System

(i)   Working space for contractor engineers which
      includes desks and access to telephones

(j)   Drawings of the ARTS III facilities and data
      necessary for development of the system
      installation plan

3.3 System Description - New functional capabilities
shall be added to and integrated with present ARTS
systems as specified in the contract. These added
improvements shall result in two general types of
systems; (a) Beacon Tracking Level Systems with
Continuous Data Recording and added functional
capabilities **(BTL** Systems), Section **3.3.1,** and **(b)**
Radar Tracking and Beacon Tracking Level Systems with
Continuous Data Recording, Fail-Soft and added
functional capabilities **(RT & BTL** Systems) Section
3.3.2.

3.3.1 BTL Systems - ARTS systems as specified in the
contract which will not be upgraded to **RT & BTL** systems

shall be modified and furnished with on-line
continuous, uninterrupted data recording capability
(CDR) and the added functional capabilities specified
in this document. A disc storage subsystem and a
medium speed printer shall be provided for this
purpose. The disc subsystem shall be comprised of two
100 megabyte disc pack drives. The contractor shall
modify existing ARTS III software as specified by the
contract and integrate additional new software required
to satisfy the provision of Sections 3.4.1 and 3.6.
Wherever necessary additional memory and an I/O channel
group shall be furnished. Figure 3-1 illustrates a
typical equipment configuration for a BTL system. See
note following Section 3.3.2.

3.3.2 RT & BTL Systems - Additional and modified
equipment as well as additional and modified software
shall be furnished those systems specified in the
contract which are to be converted to RT & BTL systems.
As a minimum, the additions and modifications shall
provide the following functions and capabilities:

(a)   Radar Target Detection and Processing
(b)   Beacon Radar Correlation and Tracking
(c)   Improved Aircraft Tracking Program
(d)   Multiprocessor Executive
(e)   Expanded Hardware and Software Applications
(f)   On-line Continuous, Uninterrupted Data
      Recording
(g)   Failure, Recovery and Reconfiguration
      (Fail-Soft)

(h)   Automatic Overload Sensing and Protection

RT & BTL systems shall have the capability to track and
display all non-beacon as well as beacon equipped
aircraft. Primary radar detection and processing shall
be enabled by the addition of a Radar Data Acquisition
Subsystem (RDAS). The modification of existing IOPs
and the addition of new IOPs with a multiprocessor
executive shall improve the existing tracking program
and enable beacon-radar correlation and tracking.
These additions shall also enable expanded applications
of added peripheral devices, such as disc storage and
medium speed printer. Continuous data recording

shall be modified and furnished with on-line continuous, uninterrupted data recording capability (CDR) and the added functional capabilities specified in this document. A disc storage subsystem and a medium speed printer shall be provided for this purpose. The disc subsystem shall be comprised of two 100 megabyte disc pack drives. The contractor shall modify existing ARTS III software as specified by the contract and integrate additional new software required to satisfy the provision of Sections 3.4.1 and 3.6. Wherever necessary additional memory and an I/O channel group shall be furnished, Figure 3-1 illustrates a typical equipment configuration for a BTL system. See note following Section 3.3.2.

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(c)   Improved Aircraft Tracking Program
(d)   Multiprocessor Executive
(e)   Expanded Hardware and Software Applications
(f)   On-line Continuous, Uninterrupted Data Recording
(g)   Failure, Recovery and Reconfiguration (Fail-Soft)

(h)   Automatic Overload Sensing and Protection

RT & BTL systems shall have the capability to track and display all non-beacon as well as beacon equipped aircraft. Primary radar detection and processing shall be enabled by the addition of a Radar Data Acquisition Subsystem (RDAS). The modification of existing IOPs 'and the addition of new IOPs with a multiprocessor executive shall improve the existing tracking program and enable beacon-radar correlation and tracking. These additions shall also enable expanded applications of added peripheral devices, such as disc storage and medium speed printer. Continuous data recording

capability shall be afforded by means of the added
peripheral devices as well as utilization of existing
peripherals. Fail-Soft capability shall be provided by
judicious application of existing and added (including
redundant) equipment and software. Availability of
secondary (beacon) detection and processing shall be
improved by the addition of a Beacon Data Acquisition
Subsystem (BDAS) for each sensor. A Beacon Control
Unit (BCU) shall be provided for each added BDAS.

Other added equipment and modifications to be furnished
by the contractor to support the functional
requirements specified in Section 3.4.2 shall include,
but not be limited to, modifications to existing IOPs
and memory modules (MMs) to the level specified in
Sections 3.5.10 and 3.5.11. A Display Buffer Memory
Module (DBMM) shall be provided for the purpose of
transferring processed data to the Data Entry and
Display Subsystem (DEDS) and refreshing and displayed
data. A Reconfiguration and Fault Detection Unit
(RFDU) and a Peripheral Switch Module (PSM) shall be
provided to enable assignment of any MM to any IOP and
the BDASs, ICA, TTY adapter, and the IMT to any one of
two IOPs.

A three disc drive system shall be provided each system
having assembly capability. All other systems shall be
provided two disc drive systems. Each disc drive shall
be capable of operating with 100 megabyte disc packs.
The disc system shall have the capability to support
failure reconfiguration and recovery, CDR requirements,
subprogram storage, and where required, software
assembly requirements. The capabilities of the basic
ARTS III system to display broadband video together
with computer derived symbology shall be retained.

Figure 3-2 shows a typical single sensor configuration
consisting of two IOPs and four MMs. Figure 3-3 shows
a typical dual sensor configuration consisting of four
IOPs and five MMs.

Note: These figures are provided for information
purposes only and do not levy any requirements on the
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capability shall be afforded by means of the added
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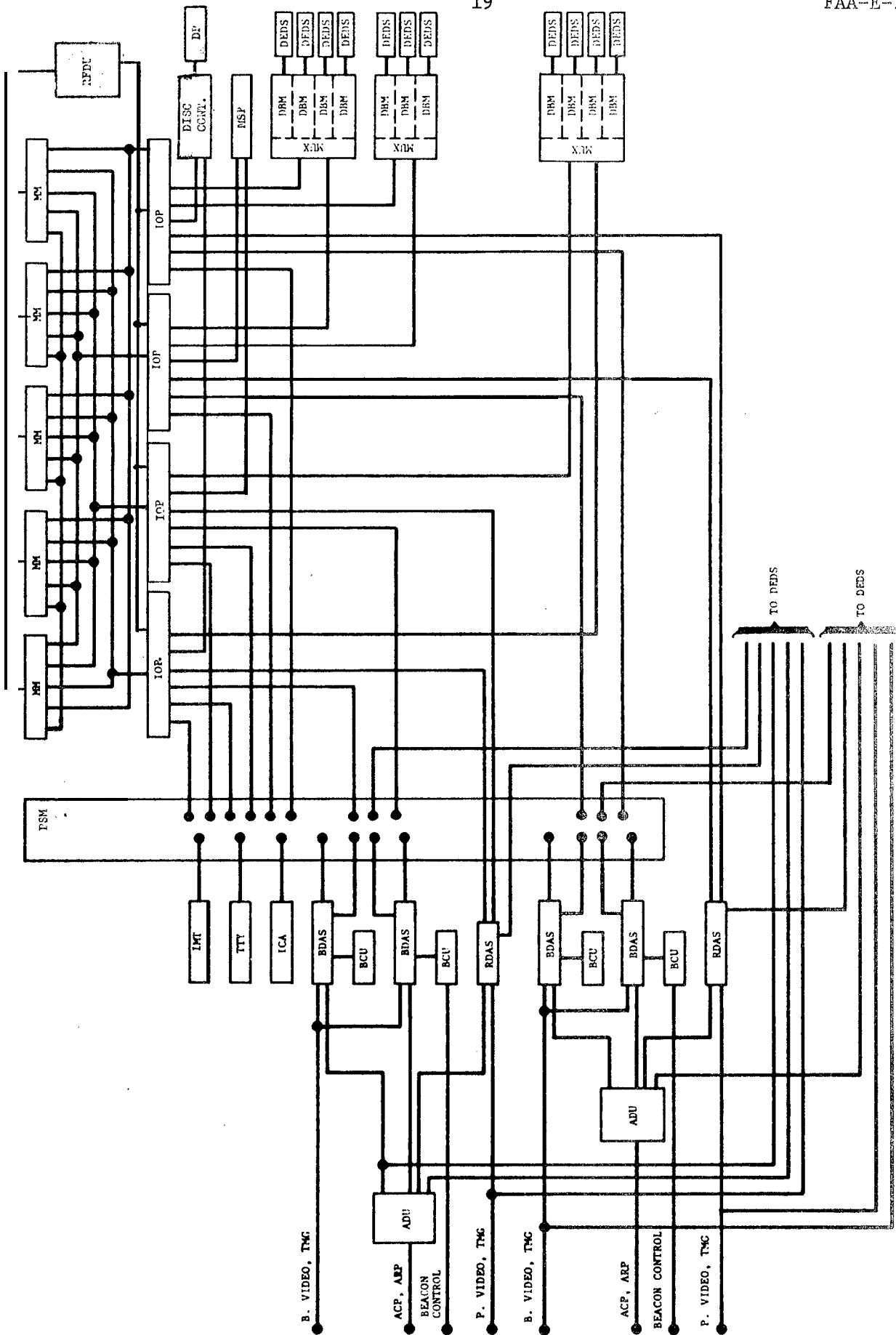FIGURE 3-3
TYPICAL DUAL R/BTL SYSTEM

3.3.3 BTL and **RT & BTL** with Additional Functions
(Ancillary Tasks) - Ancillary tasks are operational
support functions which may be conducted, as specified
herein, off-line or on-line concurrent with the full
operational program or in a degraded mode not less than
first backup level (See **3.6).** They shall include, but
not be limited to:

> **(a)** Transfer of data from one storage device to
> another. This shall include the ability to
> **re-record** on magnetic tape data already
> recorded on disc. This **task** shall provide
> the capability to transfer data between:
>
> > **1)** Disc and Disc
> > **2)** Disc and Memory
> > **3)** Magnetic Tape and Memory
> > **4)** Magnetic Tape and Disc
>
> **(b)** Storing, loading and exercise of support,
> utility, training and limited diagnostic
> programs and subprograms such as, **ETG,** BRATS,
> **TIMR, XEF, POFA** and training scenarios; i.e.,
> storage on disc so as to permit dynamic call
> up for on line or off line operation, and
> program initiation from disc.
>
> **(c)** Printing **of** program listings **on** a **MSP** or **HSP.**
>
> **(d)** Filtering, reduction, editing and printing of
> recorded data for analysis.
>
> **(e)** Building and assembly of software programs.
>
> **(f)** Diagnostics

3.3.3.1 Operational Modes - No more than **four**
operational modes shall be considered in providing
system configuration for ancillary **task** requirements.
These shall be:

> **(a)** Mode 0 - No operational capability.
>
> **(b)** Mode **1** - Operational capability no less than
> second level backup.

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4) Magnetic Tape and Disc

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utility, training and limited diagnostic
programs and subprograms such as, **ETG,** BRATS,
TIMR, XEF, POFA and training scenarios; i.e.,
storage on disc so as to permit dynamic call
up for on line or off line operation, and
program initiation from disc.

(c) Printing **of** program listings on a **MSP** or **HSP.**

(d) Filtering, reduction, editing and printing of
recorded data for analysis.

(e) Building and assembly of software programs.

(f) Diagnostics

3.3.3.1 Operational Modes - No more than **four**
operational modes shall be considered in providing
system configuration for ancillary **task** requirements.
These shall be:

(a) Mode 0 - No operational capability.

(b) Mode **1** - Operational capability no less than
second level backup.

3.4 System Functional Requirements - **BTL** and **RT & BTL** systems shall satisfy the functional requirements of current ARTS III Beacon Tracking Level Systems and the additional and/or modified functions specified herein.

3.4.1 **BTL** System Functional Requirements - Single and dual channel **BTL** systems shall be provided with the capability of **CDR** and ancillary functions. The **CDR** function shall enable the extraction of data during execution of the operational program and the recording of all or selected (filtered - See **3.6)** portions of that data on a mass storage subsystem (normally disc). An off-line capability to reduce, edit, filter, analyze and print the recorded data via an editor (See Section **3.6.1.2)** on printing equipment (normally a medium speed printer) shall be provided. An on-line capability to transfer data from disc storage to magnetic tape shall also be provided. Ancillary functions, i.e., those enabled by the existence of the disc and **MSP** subsystems, shall include the capability to store on a disc and utilize from disc, operational and utility programs and subprograms.

3.4.1.1 **BTL CDR** Requirements - The **CDR** function shall permit extraction of history and system data during the execution of the operational program and the recording of that data on a mass storage subsystem. Extraction and recording shall be continuous and uninterrupted and shall be capable of being edited, reduced and analyzed by an off-line editor (section **3.6.1.2)**. An on-line capability to transfer data from the mass storage subsystem (disc) to magnetic tape or from magnetic tape to disc shall also be provided. The extractor shall be modular to allow expansion of the data types that can be extracted and recorded. As a minimum, the capability to extract the data types listed below shall be provided. Selection of these data types shall be site adaptable. The capability of automatic initiation at system startup, as well as dynamic initiation, alteration, and termination, shall be provided on line.

    (a)   Beacon Reply Data
    (b)   Beacon Target Data
    (c)   Tracking Data
    (d)   Automatic Functions

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     (a)   Beacon Reply Data
     (b)   Beacon Target Data
     (c)   Tracking Data
     (d)   Automatic Functions

Extractor	Editor
(a) Sensor or Subsystem Number	**(a)** Sensor or Subsystem Number
(b) Azimuth Limits	**(b)** Azimuth Limits
(c) Range Limits	**(c)** Range Limits
(d) Altitude Limits	**(d)** Altitude Limits
(e) Display Number (Inhibit)	**(e)** Display Number (Selective)
(f) Beacon Code (Inhibit)	**(f)** Beacon Code (Selective)
	(g) Aircraft Identification (Selective)
	(h) Parameters Defining Time Period Limits

The extractor filters, above, shall be site adaptable for automatic initiation as well as alterable on line.

3.4.1.4 Mass Storage Subsystem (MSS) – The MSS shall be comprised of a disc storage subsystem, controller modules and a medium speed line printer. Disc drives capable of utilizing 100 megabyte disc packs shall be provided. The disc system shall afford automatic and manual interchangeability to prevent data overflow, preclude data loss due to unit failure and enhance programming and maintenance requirements.

3.4.1.4.1 BTL Ancillary Functions – A capability to utilize existing recording and printing systems **(IMT** and **ASR-37)** in conjunction with the disc subsystem equipment shall be provided. These capabilities shall include:

(a) Bootstrap loading and initialization of the

Extractor	Editor
(a) Sensor or Subsystem Number	**(a)** Sensor or Subsystem Number
(b) Azimuth Limits	**(b)** Azimuth Limits
(c) Range Limits	**(c)** Range Limits
(d) Altitude Limits	**(d)** Altitude Limits
(e) Display Number (Inhibit)	**(e)** Display Number (Selective)
(f) Beacon Code (Inhibit)	**(f)** Beacon Code (Selective)
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during the execution of the operational program and the
recording of that data on a mass storage subsystem.
Extraction and recording shall be continuous and
uninterrupted and shall be capable of being edited,
reduced and analyzed by an editor (Section 3.6.2.2.4).
It shall also afford an on-line capability to transfer
data from the mass storage subsystem (disc) to magnetic
tape or from magnetic tape to disc. The extractor
shall be modular to allow expansion of the data types
that can be extracted and recorded. As a minimum the
capability to extract the data types listed below shall
be provided. Selection of these data types shall be
site adaptable and be capable of automatic initiation
at system startup as well as dynamically alterable
on-line:

    (a) Radar Reply Data
    (b) Radar Target Data
    (c) Beacon Reply Data
    (d) Beacon Target Data
    (e) Correlated Radar and Beacon Data
    (f) Tracking Data
    (g) Automatic Functions
    (h) Manually Entered Functions
    (i) Display Data
    (j) Interfacility Input and Output Data
    (k) Error and Status Message Data
    (l) Central Track Store Files including MSAW
    (m) Sector Time

It shall be possible to select any combination of the
above data types.

Priorities shall be associated with recorded data so
that in the event of data overload, low priority data
will be discarded while maintaining, high priority data.
The function shall monitor its own operation and
generate appropriate status and error messages. Status
and error messages shall include, but not be limited
to, termination and reinitiation of the extraction of
data or data types, application or inhibition of
filters, data overflow; changeover from one recording
element to another (e.g., disc pack 1 to disc pack 2
and disc to magnetic tape unit) and CDR element

failures.

3.4.2.1.1 Normal CDR Data Requirements - The CDR function shall provide the capability to record and store all of the data specified in Section 3.4.2.1 when called upon by the program or the operator. However, normal CDR data requirements on a routine daily basis will be:

(a)   Radar Tracking Data
(b)   Beacon Tracking Data
(c)   Radar Target Reports
(d)   Beacon Target Reports
(e)   Correlated Radar and Beacon Tracking Data
(f)   Sector Time
(g)   Automatic Functions
(h)   Keyboard Input Data
(i)   Interfacility Messages

3.4.2.1.2 Dynamic Selection and Filtering of CDR Data - An operator, via any keyboard shall be able to control which of the data types will be recorded. The operator shall also be able to terminate or initiate the function as well as to modify other control parameters which filter the data to be recorded. The following filters shall be provided for both on-line and off-line editing:

Extractor	Editor
(a) Sensor or Subsystem Number	(a) Sensor or Subsystem Number
(b) Azimuth Limits	(b) Azimuth Limits
(c) Range Limits	(c) Range Limits
(d) Altitude Limits	(d) Altitude Limits
(e) Display Number (Inhibit)	(e) Display Number (Selective)
(f) Beacon Code (Inhibit)	(f) Beacon Code (Selective)

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   (f)   Sector Time
   (g)   Automatic Functions
   (h)   Keyboard Input Data
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Extractor		Editor	
(a)	Sensor or Subsystem Number	**(a)**	Sensor or Subsystem Number
(b)	Azimuth Limits	**(b)**	Azimuth Limits
(c)	Range Limits	**(c)**	Range Limits
(d)	Altitude Limits	**(d)**	Altitude Limits
(e)	Display Number (Inhibit)	**(e)**	Display Number (Selective)
(f)	Beacon Code (Inhibit)	**(f)**	Beacon Code (Selective)

3.6.1.1.16) and utility routines. This capability shall be provided so that the software subprograms may be on call, i.e., accessed on line, for **immediate functional** use in the operational program.

(e)   Automatic and manual selection of any available printer device.

(f)   Recording of operational critical data necessary to support, failure reconfiguration and recovery requirements.

(g)   Storage of minimum of two backup operational programs for failure, reconfiguration and recovery.

(h)   In addition to the above **RT & BTL** systems having assembly capability (i.e., **9300** and **UNISERVO VIC** equipment) shall be provided the capability to build and assemble complete operational software programs for **BTL** systems as well as for up to the largest program requirements of **RT & BTL** systems while maintaining an operational level no lower than first backup level (Section **3.6)** and within memory resources not exceeding that required for full system operation.

3.4.2.3 Radar Target Detection and Processing – The Radar Target Detection function shall accept radar video, azimuth, and timing inputs from an Airport Surveillance Radar **(ASR)** and use this information to generate a radar report for each detected aircraft target on each antenna scan. Radar reports shall contain target range, azimuth, and and target run length in units of azimuth change pulses. They shall be stored in **DPS** memory in a suitable format for further processing by the Radar and Beacon Tracking Logic. The radar target detection function shall be implemented through the use of a special purpose hardware unit called the Radar Data Acquisition Subsystem **(RDAS)** in conjunction with a number of stored program routines collectively referred to as the Radar Input Processing (RIP) subprogram. The **RDAS** shall

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program routines collectively referred to as the Radar
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3.4.2.3.4 Predetection - The RDAS shall perform
sequential azimuth integration on the selected hits
which are at the same range cell but on adjacent radar
sweeps. This sequential azimuth integration shall be
used to generate a **predetection** pointer which shall
indicate range cells where potential targets are
present. The **predetection** pointer shall be transferred
to the **DPS** and shall be used by the RIP software in the
final detection process.

3.4.2.3.5 Final Detection - The RIP shall perform the
final detection process by using the **predetection**
pointer as an index to the selected hits which have
been received from the **RDAS.** A detection window shall
be positioned at the range and azimuth of **the**
predetection and a target declaration shall be made
when the sum of the hits in the window exceeds a
threshold. The threshold shall be controlled
dynamically by the RIP Software. Further processing
shall be performed on detected targets to generate an
estimate of target azimuth and quality..

The azimuth estimation accuracy shall have a standard
deviation no greater than **0.2** degrees for a target 6 **db**
stronger than noise.

3.4.2.3.6 Target-Detection Control - Control shall **be**
exercised over the target detection process in order **to**
maintain false alarm control while retaining target
detection sensitivity. Four subfunctions shall be
provided for target detection control: clutter
intensity measurement, clutter mapping, clutter
correlation measurement, and detection threshold
regulation. The clutter intensity and correlation
measurement **shall be** performed in the **RDAS,** whereas the
clutter mapping and detection threshold regulation
shall be performed by the RIP software.

3.4.2.3.7 Clutter Intensity Measurement - The **RDAS**
shall contain logic to measure the clutter intensity on
each radar sweep. After each radar sweep the **RDAS**
shall transfer to the **DPS** a computer word which shall
indicate areas along the sweep wherein there exist
clutter levels.

3.4.2.3.8 Clutter Mapping - The clutter intensity indication received by the DPS from the RDAS shall be processed by the RIP software to generate two stable maps indicating the following conditions: nc clutter, and clutter. These maps, in conjunction with a manually entered ground clutter map shall be used to control the selection of hits for transfer by the RDAS to the DPS.

3.4.2.3.9 Detection Threshold Regulation - The clutter correlation indications received by the DPS from the RDAS shall be processed by RIP Software to generate stable maps indicating various levels of clutter correlation. The clutter correlation maps shall be used to regulate the final detection threshold and if required, the quantization logic to insure proper false alarm control. Final detection threshold regulation shall make use of the existence of tracked aircraft in clutter free areas to enhance detection sensitivity.

3.4.2.3.10 Analog Display Output - The RDAS shall contain an analog output channel as specified in FAA-E-2591.

3.4.2.4 Radar/Beacon Correlation and Tracking

3.4.2.4.1 Target Report Correlation - The Radar/Beacon Correlation program shall search and compare beacon and radar report store data and shall pass each report through to the target report store, as a beacon only report, a radar only report, or as a merged report.

During the processing cycle an attempt shall be made to correlate available beacon reports with available radar reports. Successful correlation shall cause the radar report to be merged with the beacon report and the resulting merged report to be stored in the merged target report store. The merged target position shall be a weighted average of the beacon and radar report positions. Successful correlation is based on the distance between the beacon and radar target positions.

3.4.2.4.2 Tracking - The tracking program shall maintain the correct association between target reports and their corresponding alphanumeric data blocks. This

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positions. Successful correlation is based on the
distance between the beacon and radar target positions.

3.4.2.4.2 Tracking - The tracking program shall
maintain the correct association between target reports
and their corresponding alphanumeric data blocks. This

operation. Failure Recovery and Reconfiguration shall
be accomplished automatically as well as by manual
procedures or by a combination of automatic and manual.
procedures. The automatic recovery sequence shall
provide that in the event of a second failure
indication in the current operating level, another
recovery shall be attempted without the use of critical
data. Note: This will preclude the possibility of bad
data in the data base causing continuous failures.

3.4.2.5.1 DPS Equipment-Module Failure

3.4.2.5.1.1 Failure Detection - Failures shall be
detected by software and hardware techniques. Error
detection shall include but not be limited to the
monitoring of parity, memory resume, memory lockout,
power, processor timeout, and illogical conditions.

3.4.2.5.1.2 Recovery and **Reconfiguraticn** Sequence -
The Recovery and Reconfiguration sequence shall be
automatic.

3.4.2.5.1.2.1 Scatter Interrupt - When a failure is
detected, a scatter interrupt shall be generated which
will stop the operational program from cycling and
force each **IOP** into its **NDRO** memory and initiate the
recovery sequence.

3.4.2.5.1.2.2 Audible Alarm - Five second audible
alarm shall be provided for the **operaticns** room. The
alarm shall have a volume control which shall allow an
adjustment range of no **preceptible** sound to a maximum
range of **80 db.** The alarm shall be enabled at the
start of the **recóvery** sequence. The recovery alarm
tone shall be clearly distinguishable from the **MSAW**
alarm tone.

3.4.2.5.1.2.3 NDRO Recovery Program - NDRO memory
shall contain a recovery program. This program shall
test the **IOPs** and **MMs** to determine which are operative
and can be used for loading the recovery module. **NDRO**
shall contain at least two selectable **NDRO** bootstrap
routines (i.e., disc and magnetic tape). The recovery
module shall be called in by the lowest numbered
operative **IOP** whose mass storage device bootstrap has

been enabled. If that load is unsuccessful, the second
lowest numbered operative IOP with mass storage device
bootstrap enabled shall attempt the load and then the
third lowest, etc. If all attempts to load the
recovery module from the mass storage device are
unsuccessful, then the load shall be attempted by the
lowest numbered IOP that has an IMT bootstrap enabled
and then second lowest, etc.

3.4.2.5.1.2.4 Recovery Module - The Recovery Module
consists of software routines that conduct detailed
checks on all DPS equipment modules. It shall
determine which equipment module(s) are operable and
then call in the highest level selected backup
operational program that can operate in those modules.
Startup of the backup operational program shall be
automatic. A capability to manually select between two
backup operational programs that utilize identical data
processing resources shall be provided. The recovery
module shall respond to the selection and load the
proper backup operational program.

3.4.2.5.1.2.5 Failure Data - All failure data shall be
output on a printer. Failure data shall include but
not be limited to:

    (a)   An IOP and MM resources map.

    (b)   The identity of the selected operational
           program.

    (c)   All data presently required on the ARTS III
           Fault Log (NAS Documentation Form 7500-65)
           shall be printed out except data not
           accessable by the operational program.

    (d)   NDRO program failure indicators.

    (e)   Recovery module failure data.

    (f)   Time of failure.

3.4.2.5.1.3 Program Storage - The capability to store
operational and support software programs on the
integral magnetic tape unit (IMT) or other mass storage

been enabled. If that load is unsuccessful, the second
lowest numbered operative IOP with mass storage device
bootstrap enabled shall attempt the load and then the
third lowest, etc. If all attempts to load the
recovery module from the mass storage device are
unsuccessful, then the load shall be attempted by the
lowest numbered IOP that has an IMT bootstrap enabled
and then second lowest, etc.

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>
> **(e)** Recovery module failure data.
>
> **(f)** Time of failure.

3.4.2.5.1.3 Program Storage - The capability to store
operational and support software programs on the
integral magnetic tape unit (IMT) or other mass storage

operational program startups.   Startup shall be
initiated by the Single Button Start on the RFDU.

3.4.2.5.2 Disc Storage Device Failure

3.4.2.5.2.1 Failure Detection - Monitoring of disc
storage device operation shall include but not be
limited to parity checks, timeout checks, reading of
test patterns -from write protect devices and the
writing and reading of test patterns on other disc
storage devices.

Two attempts to complete an operation shall be made.
If the failure condition persists after the second
attempt then a printout of the failure data shall be
made.

Two attempts to complete the operation shall then be
made through' the alternate I/O channels. The operation
shall be attempted sequentially on each channel until
'either a successfull attempt has occurred or a failure
has been encountered on all channels. Appropriate
error message printouts indicating success or
containing failure data shall be made.

If the attempts to complete the operation through the
I/O channels have all failed, then the system shall
test all disc drives to determine whether the
malfunction resides in a disc drive or in the
controller and appropriate failure data shall be
output.

3.4.2.5.2.2 Automatic Reconfiguration - When a disc
drive failure has been detected, the operation shall be
completed (when possible) by using another disc drive.

If a disc overload is sensed, an automatic switchover
to another disc shall cccur.

Except for disc drive or I/O channel failures, no
automatic reconfiguration shall be provided except that
if the recovery sequence is entered, operation shall be
as specified in Section 3.4.2.5.1.2.3.

3.4.2.5.2.3 Manual Reconfiguration - A capability to

manually energize each individual I/O channel or all
I/O channels together shall be provided on the disc
controller. Input messages shall be provided to select
which channel shall be utilized by the system.

3.4.2.5.3 TTY Failure.

3.4.2.5.3.1 Failure Detection - Failure detection
shall include but not be limited to parity and timeout
monitoring. If a timeout problem is detected, an
attempt to complete the operation through all alternate
TTY I/O channels shall be made before a failure is
declared.

3.4.2.5.3.2 Automatic Reconfiguration - The TTY
printer shall be used as the principal output device
for recording all error, failure and status
information. When a TTY failure is detected, these
messages shall be output on the MSP, so that no data is
lost.

3.4.2.5.3.3 Manual Reconfiguration - A capability to
connect the TTY to any one of two IOPs shall be
included on the PSM.

A capability to manually enter input messages from
either the TTY keyboard or a DEDS keyboard to designate
either the TTY or the MSP for the output of selected
error, failure and status messages shall be provided.

3.4.2.5.4 BDAS Failure

3.4.2.5.4.1 Failure Detection - BDAS failures shall be
detected by a combination of hardware fault monitors in
the BDAS which report failure indications to the DPS
and by the operational software. Failure detection
shall include but not be limited to range, azimuth'
interlace, test target, parity and timeout monitoring.

Failures shall be declared whenever the error rate
exceeds a predetermined threshold (SF).

Whenever a failure is declared, a printout of the
failure data shall be made.

manually energize each individual I/O channel or all I/O channels together shall be **provided** on the disc controller. Input messages shall be provided to select which channel shall be utilized by the system.

3.4.2.5.3 TTY Failure.

3.4.2.5.3.1 Failure Detection - Failure detection shall include but not be limited to parity and timeout monitoring. If a timeout problem is detected, an attempt to complete the operation through all alternate TTY I/O channels shall be made before a failure is declared.

3.4.2.5.3.2 Automatic Reconfiguration - The TTY printer shall be used as the principal output device for recording all error, failure and status information. When a TTY failure is detected, these messages shall be output on the **MSP,** so that no **data** is lost.

3.4.2.5.3.3 Manual Reconfiguration - A capability to connect the TTY to any one of two **IOPs** shall be included on the **PSM.**

A capability to manually enter input messages from either the TTY keyboard or a **DEDS** keyboard to designate either the TTY or the **MSP** for the output of selected error, failure and status messages shall be provided.

3.4.2.5.4 BDAS Failure

3.4.2.5.4.1 Failure Detection - BDAS failures shall be detected by a combination of hardware fault monitors in the **BDAS** which report failure indications to the **DPS** and by the operational software. Failure detection shall include but not be limited to range, azimuth' interlace, test target, parity and timeout **monitoring.**

Failures shall be declared whenever the error rate exceeds a predetermined threshold (SF).

Whenever a failure is declared, a printout of the failure data shall be made.

3.4.2.5.5.2 Manual Reconfiguration - A capability to manually select I/O channels shall be provided on the **RDAS as specified** in **FAA-E-2591a.**   ⟍

The operational software shall be capable of responding to these selections. An input message shall be provided to manually select which channel shall be utilized by the system if both channels are energized.

3.4.2.5.6 MDBM and **DEDS** Failures

3.4.2.5.6.1 Failure Detection - Monitoring of **MDBM** and **DEDS** operation shall include but not be limited to parity test messages, and timeout checks.

If a failure is detected, two attempts to complete the operation shall be made before a failure is declared and a failure data printout occurs.

When a failure is declared, two attempts shall then be made to complete the operation on the alternate channel and a printout indicating success or containing failure data shall be made.

No further special treatment of the error condition shall be made except as directed by manual input messages.

3.4.2.5.6.2 Manual Reconfiguration - A capability to manually select I/O **channels** shall be provided on the **MDBM.**

A manual input message capability shall be provided that shall stop or restart display output processing or keyboard input processing for any selected **DEDS.** It shall be possible to enter these messages **frcm** any **DEDS** keyboard. Whenever a restart message is entered, the failure declaration sequence of Section **3.4.2.5.6.1** shall be enabled.

3.4.2.5.7 Medium Speed Printer **(MSP)** Failure

3.4.2.5.7.1 Failure Detection - Failure detection shall include but not be limited to parity and timeout monitoring.   ⟍

3.4.2.5.5.2 Manual Reconfiguration - A capability to manually select I/O channels shall be provided on the **RDAS as specified** in **FAA-E-2591a.**

The operational software shall be capable of responding to these selections. An input message shall be provided to manually select which channel shall be utilized by the system if both channels are energized.

3.4.2.5.6 MDBM and **DEDS** Failures

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When a failure is declared, two attempts shall then be made to complete the operation on the alternate channel and a printout indicating success or containing failure data shall be made.

No further special treatment of the error condition shall be made except as directed by manual input messages.

3.4.2.5.6.2 Manual Reconfiguration - A capability to manually select I/O **channels** shall be provided on the **MDBM.**

A manual input message capability shall be provided that shall stop or restart display output processing or keyboard input processing for any selected **DEDS.** It shall be possible to enter these messages **frcm** any **DEDS** keyboard. Whenever a restart message is entered, the failure declaration sequence of Section **3.4.2.5.6.1** shall be enabled.

3.4.2.5.7 Medium Speed Printer **(MSP)** Failure

3.4.2.5.7.1 Failure Detection - Failure detection shall include but not be limited to parity and timeout monitoring.

3.4.2.5.9 Interfacility Communications Adapter **(ICA)**

3.4.2.5.9.1 Failure Detection – Failure detection shall include but not be limited to parity, timeout monitoring and test message cycling. If a failure is detected such that it appears that the **ICA** is disconnected from the I/O channel in use, two **(2)** attempts to complete the operation through the alternate I/O channel shall **be** made before a failure is declared and a failure printout generated.

3.4.2.5.9.2 Automatic Reconfiguration - No automatic' reconfiguration shall be provided.

3.4.2.5.9.3 Manual Reconfiguration – A **capability** to connect the **ICA** to either one of two **IOPs** shall be provided on the **PSM.** The system shall be capable of determining (automatically) which I/O channel is connected to the **ICA.**

3.4.2.6 Multiprocessing – The **IOP** shall contain features specifically designed to provide an efficient **multiprocessing** capability. These features shall include but not **be** limited to:

(a) Memory lockout

(b) Relative memory addressing

(c) Table access control

(d) Biased load and store

The multiprocessing executive shall meet the' requirements of Section **3.6.2.1.1.1.1** and shall be designed to make maximum use of the **IOP** multiprocessing features to ensure that an efficient use of data processing resources is obtained **when executing** the operational program(s).

3.4.2.7 Automatic Overload Sensing and Protection – To assure sustained processing power for air traffic control priorities,' the contractor shall furnish software capability to automatically sense and protect against primary radar data overload situations (e.g.,

radar malfunction/failure, jamming and intense weather echoes). When an overload situation occurs, radar data processing shall be discriminately and dynamically reduced in a manner assuring optimum operational capability. That is, radar processing shall be inhibited in those azimuthal portions of the scan where the input data rate is excessive. Those portions of the radar scan where the data rate is normal or low shall not be affected.

3.4.2.7.1 Keyboard Inputs - A **DEDS** keyboard input action shall be provided that will enable or disable this function. A teletype printout shall follow the action indicating the status of the function.,

3.4.2.7.2 Display Output - An indication of the azimuth segments wherein radar data processing is inhibited shall be presented on the **DEDS.**

3.4.2.7.3 CDR - A **CDR** output shall be provided each scan that radar data processing is inhibited.. The output shall indicate which segments are affected. This output shall be considered as one of the Automatic Function data types.

3.5 Equipment Requirements - The existing ARTS III hardware systems shall be **modularly** expanded and modified to meet the functional capabilities as specified herein. As a minimum the following equipment shall be furnished; in accordance with **FAA-E-2591a:**

    (a) Radar Data Acquisition Subsystem **(RDAS)**

    (b) Beacon Data Acquisition Subsystem **(BDAS)**

    (c) Beacon Control Unit **(BCU)**

    (d) Azimuth Distribution Unit **(ADU)**

    (e) Disc Subsystem

    (f) **Reconfiguraticn** and Fault **Dtection** Unit **(RFDU)**

    (g) Multiplexed Display Buffer Memory **(MDBM)**

radar malfunction/failure, jamming and intense weather echoes). When an overload situation occurs, radar data processing shall be discriminately and dynamically reduced in a manner assuring optimum operational capability. That is, radar processing shall be inhibited in those azimuthal portions of the scan where the input data rate is excessive. Those portions of the radar scan where the data rate is normal or low shall not be affected.

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(a) Radar Data Acquisition Subsystem **(RDAS)**

(b) Beacon Data Acquisition Subsystem **(BDAS)**

(c) Beacon Control Unit **(BCU)**

(d) Azimuth Distribution Unit **(ADU)**

(e) Disc Subsystem

(f) **Reconfiguraticn** and Fault **Dtection** Unit **(RFDU)**

(g) Multiplexed Display Buffer Memory **(MDBM)**

3.5.5 **Disc** Subsystem - One dual channel disc subsystem
shall be provided for each **BTL** and **RT** **&** **BTL** system.
The disc subsystem for non-assembly facilities shall
consist of one disc controller and two disc drives.
The disc subsystem for assembly facilities shall
consist of one disc controller and three disc drives.

3.5.6 Reconfiguration and Fault Detection Unit **(RFDU)**
- The **RFDU** shall provide automatic confguration control
of **IOPs** and **MMs** for both the single and dual **RT & BTL**
systems, per the requirements of **FAA-E-2591a.** In
addition, there will be a manual switching capability
to fully isolate an MM or **IOP** from the remaining
system.

3.5.7 Multiplexed Display Buffer Memory **(MDBM)** - The
MDBM shall consist of redundant
multiplexers/Demultiplexers and a number of Display
Buffer Memory Modules **(DBMMs)**. The number of **MDBM's**
and **DBMM's** shall be determined by the number of
displays at each facility. The **MDBM** shall meet the
requirements of **FAA-E-2591a.**

3.5.8 Input/Output Processor **(IOP)** - Existing **IOPs** at
RT & BTL facilities shall be modified **tc** convert them
to **FA-8303B** type **IOPs.** Additional **IOPs** shall be
provided as necessary to meet the processing
requirements as specified herein and in the contract.
The **IOPs** shall meet the requirements of **FAA-E-2591a.**

Sufficient cabinets **(FA-8301)**, DC/DC Power Converters
(FA-8307B) and AC/DC Regulators **(FA-8308B)** that meet
the requirements of **FAA-E-2591a** shall be provided to
house and power the **IOPs.**

3.5.9 Memory Modules (MM) - Existing **MMs** at **RT & BTL**
facilities shall be modified to meet the MM
requirements of **FAA-E-259 la.** Additional **MMs** shall be
provided as necessary to meet the processing
requirements as specified herein and in the contract.
These **MMs** shall also meet the requirements of
FAA-E-2591a.

Sufficient cabinets **(FA-8301)**, DC/DC Power Converters
(FA-8307C), and AC/DC Regulators **(FA-8308B)** that meet

the requirements of **FAA-E-2591a** shall be provided to
house and power the **MMs.**

. **3.5.10** Central Memory Access Module **(CMA)** - **CMAs** shall
be provided for those data processing subsystems where
the. number of **IOPs and/or MMs** are such that a **CMA** is
required.   The **CMAs** shall meet the requirements of
FAA-E-2591a.   Where **CMAs** are provided, the memory
modules are to be modified for single port operation.

3.5.11   Medium Speed Printer **(MSP)** - An **MSP** shall be
provided for each **BTL** and **RT & BTL** system.   The **MSP**
shall meet the requirements of **FAA-E-2591a.**

3.5.12 Break Point Module **(BPM)** - A **BPM** shall be
provided and have the following functions.   It shall be
an **18** bit, 6 function switch selectable device that
shall be capable of stopping the **IOP** in selected Store,
Fetch or Instruction sequences and in address
conditions of Less Than, Equal or Greater Than a
preselected **18** bit address.   The **BPM** shall be capable
of operation in any non-exclusive combination of the
six conditions.

3.5.13 Peripheral Switch Module **(PSM)** - The **PSM** shall
provide manual configuration control of **IOPs** and
peripheral equipment per the requirements of
FAA-E-2591a.

3.6 Software Requirements - Separate software shall be
provided for **BTL systems** (section **3.6.1)** and for **RT&BTL**
systems (section **3.6.2).**

3.6.1 BTL Software - **Cperational** software (section
3.6.1.1) and support software (section **3.6.1.2)** shall
be provided for the **BTL** systems.

3.6.1.1 Operational **BTL** Software - **BTL** operational
software shall **ccnsist** of mutually agreed upon FAA
released ARTS III software modified by the addition of
the Continuous Data Recording **(CDR)** software described
below.   The **BTL** software shall be such that the **BTL**
system with **CDR** is functionally identical to the
existing **BTL** systems as specified in the contract
except that added **CDR** functions shall be provided.   The

the requirements of **FAA-E-2591a** shall be provided to house and power the **MMs.**

. **3.5.10** Central Memory Access Module **(CMA) - CMAs** shall be provided for those data processing subsystems where the. number of **IOPs and/or MMs** are such that a **CMA** is required. The **CMAs** shall meet the requirements of **FAA-E-2591a.** Where **CMAs** are provided, the memory modules are to be modified for single port operation.

3.5.11 Medium Speed Printer **(MSP)** - An **MSP** shall be provided for each **BTL** and **RT & BTL** system. The **MSP** shall meet the requirements of **FAA-E-2591a.**

3.5.12 Break Point Module **(BPM)** - A **BPM** shall be provided and have the following functions. It shall be an **18** bit, 6 function switch selectable device that shall be capable of stopping the **IOP** in selected Store, Fetch or Instruction sequences and in address conditions of Less Than, Equal or Greater Than a preselected **18** bit address. The **BPM** shall be capable of operation in any non-exclusive combination of the six conditions.

3.5.13 Peripheral Switch Module **(PSM)** - The **PSM** shall provide manual configuration control of **IOPs** and peripheral equipment per the requirements of **FAA-E-2591a.**

3.6 Software Requirements - Separate software shall be provided for **BTL systems** (section **3.6.1)** and for **RT&BTL** systems (section **3.6.2).**

3.6.1 BTL Software - **Operational** software (section **3.6.1.1)** and support software (section **3.6.1.2)** shall be provided for the **BTL** systems.

3.6.1.1 Operational **BTL** Software - **BTL** operational software shall **consist** of mutually agreed upon FAA released ARTS III software modified by the addition of the Continuous Data Recording **(CDR)** software described below. The **BTL** software shall be such that the **BTL** system with **CDR** is functionally identical to the existing **BTL** systems as specified in the contract except that added **CDR** functions shall be provided.   The

program is in operation.

In the event that a buffer area becomes full before another is available, i.e., recording is not completed, a "Data Loss" condition shall exist. This condition shall result in the following action:

(a)   The program shall stop extracting data selectively on the basis of software adapted priorities. The data having the lower priority shall be deleted first. If deletion of more than one type data becomes necessary, the next lowest priority data shall be deleted. Priorities shall be as follows (where the lowest priority has the highest number):

1.   Track Data

2.   Target Data

3.   Interfacility Input and Output Data

4.   Keyboard Entries

5.   Reply Data

6.   All other data

(b)   A printout noting the time of data loss and the type of data no longer being extracted shall occur on the appropriate printer.

(c)   Extraction of the suspended data shall be automatically reintiated in priority order when the overload situation is cleared. A printout shall occur noting the time and type data being restored.

(d)   Overload conditions shall not affect the operational program.

3.6.1.1.1.1 Automatic Initiation of Extraction - When system startup is completed, CDR shall be automatically initiated by commencing extraction using a standard set

of data (site adaptable) with standard (site adaptable)
limitations (filters). Selective extraction of a
specific data may be inhibited or enabled or filter
limitations entered by keyboard entries. When the
extractor is initiated automatically or manually, it
shall write the data via the buffer areas on the
designated recording media. When the area designated
for writing data within a disc pack is filled an
automatic transfer to the standby disc pack shall
occur. When magnetic tape is used, in the event of
disc failure it shall be manually initiated and
continue writing until it receives an end of tape
interrupt or is manually switched. The extractor shall
initiate the disc unit designated **"available"**
(automatically or by manual switch action) and continue
output on that element. When the end of tape or manual
interrupt is received on the magnetic tape unit a tape
mark shall be written on the tape and the transport
shall rewind to **BOT.** Whenever a transfer from one
recording element (disc to disc, disc to tape or tape
to disc) to another occurs, a message indicating the
time and status **of the** extractor shall be output on the
TTY printer, or **MSP if** so designated. If at any time,
including, initiation, interrupts are received from the
designated disc indicating a failure or not ready, the
extractor shall switch to the alternate disc. In all
of the foregoing cases a message indicating time and
extractor status shall be printed on the TTY printer,
or **MSP,** if so designated.

3.6.1.1.1.2 Extractor Control - The extractor shall be
controlled by input messages from any display console
alphanumeric keyboard **cr** TTY having supervisory status.
The operator shall be provided the capability to
initiate extraction, **select,** add to, or inhibit
extraction types, alter filter controls and terminate
extraction while the main program is operating. The
following filters shall exist and may be used in any
combination:

   (a)   Sensor or Subsystem Number

   (b)   Azimuth Limits

   (c)   Range Limits

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limitations (filters). Selective extraction of a
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following filters shall exist and may be used in any
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   (a)   Sensor or Subsystem Number

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   (c)   Range Limits

data output to the specified displays.

Filters designated sensor oriented shall be applicable
separately and independently to each sensor. They
shall also be automatically initiated, per local
adaptation, upon startup and dynamically alterable on
line.

3.6.1.1.1.2.1 Keyboard Messages - Keyboard messages
shall consist of fields. The first two should be, for
example, **"F7"** and **X.** These should be followed by
qualifying (data type) fields specifying the functions
to be performed and the limitation of that performance.
A record of all keyboard entries shall be printed on
the TTY printer, or the **MSP,** if so designated.

3.6.1.1.1.2.2 Manual **CDR** Program Initiation, Date and
Time - Upon automatic initiation at startup, the **CDR**
program shall make reference to and record the computer
system time until it is updated to chronological time
by the operator. At, this point, the **CDR** program shall
record that time sequence in hours, minutes and
milliseconds. A keyboard message shall be used to
enter the date. When the **F7,** X message is followed by
fields containing **EE,** two digits of the day, two digits
of the month and two digits of the year, the **CDR**
program shall be initiated, or continue to operate if
already enabled and immediately commence updating the
entered date value on a daily and monthly basis until
the program is manually or otherwise terminated. When
the initiation/date message is further followed with
fields containing **RM, X** (where X equals **0, 1, 2)** it
shall designate the recording media; 0 = magnetic tape,
1 = disc drive **1,** and 2 = disc drive **2.** If a recording
unit is not specified disc drive **1** shall be assumed.

3.6.1.1.1.2.3 Data Type and Control - The following
keyboard messages shall permit dynamic suppression or
reinitiation of the extraction of the data or specified
data type(s). The entry of a reinitiation message for
a data type whether inhibited or not inhibited, shall
alter its priority for automatic suspension to the
highest level. That is, the first data type to be
reinitiated shall maintain highest priority until a
second data type is reinitiated. Then it would be

data output to the specified displays.

Filters designated sensor oriented shall be applicable
separately and independently to each sensor.   They
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by the operator.   At, this point, the **CDR** program shall
record that time sequence in hours, minutes and
milliseconds.   A keyboard message shall be used to
enter the date.   When the **F7,** X message is followed by
fields containing **EE,** two digits of the day, two digits
of the month and two digits of the year, the **CDR**
program shall be initiated, or continue to operate if
already enabled and immediately commence updating the
entered date value on a daily and monthly basis until
the program is manually or otherwise terminated.   When
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alter its priority for automatic suspension to the
highest level.   That is, the first data type to be
reinitiated shall maintain highest priority until a
second data type is reinitiated.   Then it would be

ENTRY		FUNCTION	DATA TYPE
Enable	Inhibit		
ER	IR*	Enable/Inhibit Extraction of	Radar Data**
EB	IB*	Enable/Inhibit Extraction of	Beacon Replies
ET	IT*	Enable/Inhibit Extraction of	Target Reports
EF	IF	Enable/Inhibit Extraction of	Tracking Data
EK	IK	Enable/Inhibit Extraction of	Keyboard Data
EI	II	Enable/Inhibit Extraction of	Interfacility Input Messages
EO	IO	Enable/Inhibit Extraction of	Interfacility Output Messages
EA	IA	Enable/Inhibit Extraction of	Automatic Functions
EM	IM	Enable/Inhibit Extraction of	Magnetic Tape Flight Plans
ES	IS	Enable/ Inhibit Extraction of	System Data (Memory Dump)
ED	ID	Enable/Inhibit Extraction of	Display Data
EE(da, mo, yr)	IE	Enable/Inhibit	Extractor (All Data)

* Sensor 0 or 1 — If neither is entered all available shall be assumed.

** RT & BTL Systems only.

Note: The above messages shall be enterable in the multiple mode.

ENTRY		FUNCTION	DATA TYPE
Enable	Inhibit		
ER	IR*	Enable/Inhibit Extraction of	Radar Data**
EB	IB*	Enable/Inhibit Extraction of	Beacon Replies
ET	IT*	Enable/Inhibit Extraction of	Target Reports
EF	IF	Enable/Inhibit Extraction of	Tracking Data
EK	IK	Enable/Inhibit Extraction of	Keyboard Data
EI	II	Enable/Inhibit Extraction of	Interfacility Input Messages
EO	IO	Enable/Inhibit Extraction of	Interfacility Output Messages
EA	IA	Enable/Inhibit Extraction of	Automatic Functions
EM	IM	Enable/Inhibit Extraction of	Magnetic Tape Flight Plans
ES	IS	Enable/ Inhibit Extraction of	System Data (Memory Dump)
ED	ID	Enable/Inhibit Extraction of	Display Data
EE(da, mo, yr)	IE	Enable/Inhibit	Extractor (All Data)

* Sensor Ø or 1 — If neither is entered all available shall be
  assumed.

** RT & BTL Systems only.

Note: The above messages shall be enterable in the multiple mode.

MESSAGE OUTPUT			DESCRIPTION
DR START	(K)	(Time)	Initialize Extractor
DR STOP-M	(K)	(Time)	Manual Extractor Termination
DR STOP	(M)	(Time)	Program Extractor Termination
DR ADEL MAG		(Time)	Auto Delete Mag Tape Flight Plans
DR ADEL IF		(Time)	Auto Delete Interfacility Messages
DR ADEL AUT		(Time)	Auto Delete Auto Functions
DR ADEL KBD		(Time)	Auto Delete Keyboard Data
DR ADEL TRK (Sensor)		(Time)	Auto Delete Tracking Data
DR ADEL TGR (Sensor)		(Time)	Auto Delete Target Reports
DR ADEL BNR (Sensor)		(Time)	Auto Delete Beacon Replies
DR ADEL RVD (Sensor)		(Time)	Auto Delete Radar Data
DR ARES MAG		(Time)	Auto Resume Mag Tape Flight Plans
DR ARES IF		(Time)	Auto Resume Interfacility
DR ARES AUT		(Time)	Auto Resume Auto Functions
DR ARES KBD		(Time)	Auto Resume Keyboard Data
DR ARES TRK (Sensor)		(Time)	Auto Resume Tracking Data
DR ARES TGR (Sensor)		(Time)	Auto Resume Target Reports
DR ARES BNR (Sensor)		(Time)	Auto Resume Beacon Replies
DR ARES RVD (Sensor)		(Time)	Auto Resume Radar Data Input
DR MDEL MAG	(K)	(Time)	Manual Delete Mag Tape Flight Plans
DR MDEL IF	(K)	(Time)	Manual Delete Interfacility
DR MDEL AUT	(K)	(Time)	Manual Delete Auto Functions
DR MDEL KBD	(K)	(Time)	Manual Delete Keyboard Data
DR MDEL TRK	(K) (Sensor)	(Time)	Manual Delete Tracking Data
DR MDEL TGR	(K) (Sensor)	(Time)	Manual Delete Target Report
DR MDEL BNR	(K) (Sensor)	(Time)	Manual Delete Beacon Replies
DR MDEL RVD	(K) (Sensor)	(Time)	Manual Delete Radar Data Input
DR MRES MAG	(K)	(Time)	Manual Resume Mag Tape Flight Plans
DR MRES IF	(K)	(Time)	Manual Resume Interfacility
DR MRES AUT	(K)	(Time)	Manual Resume Auto Functions
DR MRES KBD	(K)	(Time)	Manual Resume Keyboard Data
DR MRES TRK	(K) (Sensor)	(Time)	Manual Resume Tracking Data
DR MRES TGR	(K) (Sensor)	(Time)	Manual Resume Target Reports
DR MRES BNR	(K) (Sensor)	(Time)	Manual Resume Beacon Replies
DR MRES RVD	(K) (Sensor)	(Time)	Manual Resume Radar Data

3.6.1.1.2 Enhanced Target Generator - A capability shall exist to simulate the activities of a number of aircraft. The target generator shall accept commands from display keyboards or from a scenario magnetic tape (prepared off-line) to simulate the flight paths of up to 64 independent aircraft. The target generator shall accept parameter inputs from the display keyboard, and the scenario magnetic tape to control the mode of operation as well as the characteristics of targets. Commands shall control the following target characteristics.

(a)   Beacon code and validity

(b)   Altitude and validity

(c)   Rate of ascent/descent

(d)   Range

(e)   Heading

(f)   Rate of Change of Heading

(g)   speed

(h)   Acceleration/Deceleration

(i)   Special Position Indicator (SPI)

(j)   Weak/Strong Target

(k)   Radar and/or Beacon Targets

(l)   Radar Target Run Length

The target generator shall have the following general functional capabilities:

(a)   Add noise in target position.

(b)   Duplicate targets.

(c)   Ring targets.

3.6.1.1.2 Enhanced Target Generator - A capability shall exist to simulate the activities of a number of aircraft. The target generator shall accept commands from display keyboards or from a scenario magnetic tape (prepared off-line) to simulate the flight paths of up to 64 independent aircraft. The target generator shall accept parameter inputs from the display keyboard, and the scenario magnetic tape to control the mode of operation as well as the characteristics of targets. Commands shall control the following target characteristics.

(a)   Beacon code and validity

(b)   Altitude and validity

(c)   Rate of ascent/descent

(d)   Range

(e)   Heading

(f)   Rate of Change of Heading

(g)   speed

(h)   Acceleration/Deceleration

(i)   Special Position Indicator (SPI)

(j)   Weak/Strong Target

(k)   Radar and/or Beacon Targets

(l)   Radar Target Run Length

The target generator shall have the following general functional capabilities:

(a)   Add noise in target position.

(b)   Duplicate targets.

(c)   Ring targets.

'standard IOP procedures from either the IMT or from a
mass media storage unit.   The operator shall have
control of the data filter limits as specified in
3.6.1.2.1.1 and the following data types:

(a)   Radar Data (RT & BTL only).

1.   Replies

2.   Reports

(b)   Beacon Data

1.   Replies

2.   Reports

(c)   Tracking Data

(d)   Auto Functions

(e)   Keyboard Input

(f)   Interfacility

1.   Input

2.   output

(g)   Central Track Store Files including MSAW

(h)   Bulk Store Flight Plans

(i)   Display Data

(j)   Error and Status Message Data

It shall be possible to select all, any one, or any
combination of the above.

Following a program start the console teletypewriter
shall print: ENTER DATA TYPE(s).

A carriage return shall be entered if all types of data
are to be listed.   Otherwise, letters specifying which

'standard IOP procedures from either the IMT or from a
mass media storage unit. The operator shall have
control of the data filter limits as specified in
3.6.1.2.1.1 and the following data types:

(a)   Radar Data (RT & BTL only).

   I.   Replies

   2.   Reports

(b)   Beacon Data

   I.   Replies

   2.   Reports

(c)   Tracking Data

(d)   Auto Functions

(e)   Keyboard Input

(f)   Interfacility

   1.   Input

   2.   output

(g)   Central Track Store Files including MSAW

(h)   Bulk Store Flight Plans

(i)   Display Data

(j)   Error and Status Message Data

It shall be possible to select all, any one, or any
combination of the above.

Following a program start the console teletypewriter
shall print: ENTER DATA TYPE(s).

A carriage return shall be entered if all types of data
are to be listed. Otherwise, letters specifying which

(e)   Beacon Code (Discrete or Nondiscrete Blocks)
(f)   Aircraft ID
(g)   Altitude Limits
(h)   Display Number
(i)   Interfacility Messages (data type **PP**, AM, **CX, TA, TI, TU,** CA, **DX, DR, TR, DT, DM)**
(j)   Tracking Data (controlled and uncontrolled)

All filters shall be capable of operating simultaneously or in any combination and they shall be selectable by keyboard entry. The aircraft ID filter shall handle up to five aircraft at once. The beacon code shall be able to handle up to five beacon codes at once.

3.6.1.2.1.2 **CDR** Editor Output - **CDR** editor output shall include, but not be limited to, the following:

(a)   If more than one data category has been entered, the first data category entered shall be printed first.

(b)   Each category of data shall have its own format and column heading which shall be printed on all sheets containing that data category.

(c)   A capability for beacon data reduction which shall enable:

   o   Printing all duplicate beacon reports for any scan in which a duplicate report is **found.**

   o   Printing all duplicate beacon reports of any selected. code block for any scan in which a duplicate is found.

   o   Printing all **dupicate** beacon reports of any selected discrete **code** for any scan in which a duplicate is found.

(d)   For each type of data reduction the following statistics for each scan shall be provided:

(e)   Beacon Code (Discrete or Nondiscrete Blocks)
(f)   Aircraft ID
(g)   Altitude Limits
(h)   Display Number
(i)   Interfacility Messages (data type **PP**, AM, **CX**, **TA, TI, TU,** CA, **DX, DR, TR, DT, DM**)
(j)   Tracking Data (controlled and uncontrolled)

All filters shall be capable of operating simultaneously or in any combination and they shall be selectable by keyboard entry.   The aircraft ID filter shall handle up to five aircraft at once.   The beacon code shall be able to handle up to five beacon codes at once.

3.6.1.2.1.2 CDR Editor Output – CDR editor output shall include, but not be limited to, the following:

(a)   If more than one data category has been entered, the first data category entered shall be printed first.

(b)   Each category of data shall have its own format and column heading which shall be printed on all sheets containing that data category.

(c)   A capability for beacon data reduction which shall enable:

   o   Printing all duplicate beacon reports for any scan in which a duplicate report is **found.**

   o   Printing all duplicate beacon reports of any selected. code block for any scan in which a duplicate is found.

   o   Printing all **dupicate** beacon reports of any selected discrete **code** for any scan in which a duplicate is found.

(d)   For each type of data reduction the following statistics for each scan shall be provided:

independent functions shall be segmented into separate
subprograms (tasks). It shall be possible to change,
delete, or add to one or more subprograms without
affecting the remaining (unchanged) portions of the
operational program. All parts of an operational
program must be relocatable within main memory.

Each task shall be capable of assembly independent of
the executive and other tasks. A capability shall.
exist to modify, insert, or delete tasks without
changing the executive or the unaffected tasks.

3.6.2.1.1 Single **RT & BTL** Operational Software - The
operational software to be provided for single **RT & BTL**
sites will include:

   (a) Full Capability Single **RT & BTL** Operational
   Program (Section **3.6.2.1.1.1)**

   (b) First Backup Single **RT & BTL** Operational
   Program (Section **3.6.2.1.1.2)**

   (c) Second Backup Single **RT & BTL** Operational
   Program (Section **3.6.2.1.1.3)**

Whenever system degrading and reconfiguration is
necessary an interfacility **"stop** send" message shall be
transmitted. When reconfiguration is completed an
Interfacility **"start** send" message shall be ,
transmitted.

First backup software shall be a subset of full
capability software. Whenever a failure occurs or at
the time of initialization (see section **3.4.3.3)**, the
system will always choose the highest level program
consistent with available hardware, where full
capability ranks highest, first backup next, and second
backup ranks third. An indication of the operating
program level shall be displayed on the **DEDS** at all
times.

During normal operation, that is with all **IOPs** and **MMs**
operating properly, the full capability software
controls the system. At this time, this software is
resident in main memory, and backup software and a copy

of full capability software is on a mass storage
device. If, in the event of failures, or for any other
reasons, **there** is insufficient properly operating
hardware for full capability software operation, first
backup software will automatically be placed in main
memory and assume control of the system. When
sufficient properly operating hardware again becomes
available, full capability software will replace first
backup software for control of the system. This
replacement will be initiated by an input command.

The source **RT & BTL** program for all three **RT & BTL**
Operational Programs shall be the same. Through the
use of the assembler and the Builder, this Source **RT &
BTL** program shall be capable of being **assembled** into
any one of the three types of **RT & BTL** Operational
Programs (the object **RT & BTL** Operational Programs)
mentioned above and placed on a mass storage device
suitable for bootstrap loading. Recursive and
re-entrant coding techniques shall **be** available for use
in both the Multiprocessor Executive and the tasks.

3.6.2.1.1.1 Full Capability Single **RT & BTL**
Operational Program - The full capability single **RT &
BTL** operational program shall be composed of a
Multiprocessing Executive (see **section 3.6.2.1.1.1.1)**,
functional tasks, and a System Data Base (see section
3.6.2.1.1.1.1.7). These functional tasks are:

    (a)   Beacon Input Processing (see section
           3.6.2.1.1.1.2)

    (b)   Radar Input Processing (see section
           3.6.2.1.1.1.3)

    (c)   Radar/Beacon Correlation (see section
           3.6.2.1.1.1.4)

    (d)   Radar/Beacon Tracking (see section
           3.6.2.1.1.1.5)

    (e)   Keyboard Input Processing (see section
           3.6.2.1.1.1.6)

    (f)   Display Output Processing (see section

of full capability software is on a mass storage
device. If, in the event of failures, or for any other
reasons, there is insufficient properly operating
hardware for full capability software operation, first
backup software will automatically be placed in main
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(b)   Radar Input Processing (see section
      3.6.2.1.1.1.3)

(c)   Radar/Beacon Correlation (see section
      3.6.2.1.1.1.4)

(d)   Radar/Beacon Tracking (see section
      3.6.2.1.1.1.5)

(e)   Keyboard Input Processing (see section
      3.6.2.1.1.1.6)

(f)   Display Output Processing (see section

so that highly interfacing tasks (memory fetch
interference or simultaneous access to a given data
item) shall not frequently be executed at the **same**
time. This shall be achieved in the executive
'controlled system through the preplan of the
parallelism among tasks; That is, the majority of
tasks shall be prescheduled within a network of other
tasks. **This network,** called a lattice, shall describe
all tasks which are prerequisites for any given task
and all tasks which are successors to the given tasks.
Tasks scheduled **via** a lattice are called **"planned"**
tasks. Tasks which have aperiodic scheduling
characteristics are called **"popup"** tasks. A list of
popup tasks entrance times shall be maintained and
popup task entrance control performed accordingly by
the Executive.

The executive shall **provide** the basic functions of
system **initialization,** task scheduling, servicing
request, **controlling** interrupts, and system recovery
(not otherwise handled by **NDRO** or off-line software).
These functions are described below. To facilitate
system growth or changes, **executive** functions may be
added, changed, or deleted, even though some **executive**
functions may share the same tasks and portions of the
data base.

The Executive shall **provide** for:

(a) System Initialization - The capability to
initialize the system hardware and software
for either an **inital** system start or a
recovery restart **(start over).** Parts of the
system initialization function may be
contained in the executive. Initialization
shall be controlled by a single **IOP.**

(b) Task Scheduling - Task scheduling for the'
dispatch of program control to tasks within
the operational Program. Two types of query
shall exist within the scheduler: the **popup**
query and the planned query. The **popup** query
shall provide high priority entrance to tasks
which are aperiodic or for which excessive
overhead would exist if they were planned.

The planned capability shall provide a number,
of lattice frameworks in which tasks may be
placed so that entrance is dependent upon the
prior completion of other tasks or the lapse
of a given amount of time. Tasks may be
scheduled as both a **popup** and a planned task.
This feature will **permit** a task to be
scheduled periodically and yet still provide
a fast response for critical functions.

(c)   Executive Service Requests **(ESRs)** - A set of
       ESRs **shall** be made available to tasks for the.
       general capabilities of I/O control,
       scheduling control, privileged instruction
       execution, and normal task exit. The
       Teletype handler shall provide an I/O message
       control capability for operator/task and
       operator/executive interface. Logical to
       physical I/O device assignments and their
       backups shall be site adaptable.

(d)   Interrupt Control - An interrupt capability
       to control all levels of both **intraprocessor**
       and interprocessor interrupt conditions.
       There shall be two types of interprocessor
       interrupts. One type is for input/ output
       and originates in the **ESR** routine, and the
       other type shall inform the non-initializing
       processors that the initialization is
       complete and to proceed with normal task
       scheduling.

(e)   Recovery - In the event of detection of a
       system error, the Recovery and
       Reconfiguration Sequence (see section
       3.4.2.5) shall be initiated. Portions of the
       function of recovery and reconfiguration may
       be contained in the executive.

3.6.2.1.1.1.2 Beacon Input Processing - The Beacon
Input Processing **(BIP)** tasks shall accept and process
replies from the Beacon Data Acquisition Subsystem
(BDAS), correlate them on a sweep-to-sweep basis to
detect targets, and store the declared target messages
for use by the beacon/radar correlation subprogram.

The beacon input processing tasks shall also monitor
BDAS/BIP performance. Functionally, the beacon input
processing tasks shall perform as per NAS-MD-606 with
the exception that BIP shall be operated on a schedule
basis.

The input received from the BDAS for each sweep shall
consist of an interrupt word, an initial word, and up
to 30 reply words. The initial word shall be checked
for reasonable azimuth, proper interrogation mode (mode
interlace), and alarm bit setting. Alarm printouts
shall be generated in case of failure or error
condition.

The reply words shall be used for correlation with
previously received reply words for possible generation
of target report messages. System parameters shall be
used for determining firm targets, split targets, and
ring-around conditions. Declaration of a firm target
shall result in the storage of applicable data in the
beacon target report store for subsequent processing by
the beacon/radar correlation subprogram. This data
shall consist of range, center azimuth, mode 3/A code,
mode C code (if present), validity field for each code,
SPI bit, and, a weak/strong target indicator based on
azimuth confidence. Mcde C validity shall be checked
at all times. A count of the interrupts received shall
be maintained to determine Pulse Repetition Frequency
(PRF), rate and an alarm printout shall be initiated if
the count is not within limits.   \

Receipt of an internal test target shall also be
verified once each scan. A test target shall be
located approximately 32 ACPs in a clockwise direction
from 180 degrees at a range of 59 1/16 nautical miles.
Failure to locate the BDAS test generated target shall
result in a error printout.

3.6.2.1.1.1.3 Radar Input Processing – The Radar Input
Processing (RIP) program shall ccntrol the RDAS/RIP
interface. It shall process the RDAS data for the
statistical detection and position reporting of radar
replies. It shall additionally provide the control for
the RDAS video channel selection, weather hit
regulation, and other computer selectable operating

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regulation, and other computer selectable operating

conditions.

(1) Control the generation and positioning of the
Realtime Quality Control **(RTQC)** test target.

(m) Control **RDAS** alarm indications

(n) Provide overload sensing and protection

3.6.2.1.1.1.4 Radar/Beacon Correlation - The
Radar/Beacon Correlaticn Functions shall combine radar
and beacon reports received from the same aircraft into
one merged radar reinforced beacon report.   The
position estimate for the radar reinforced report shall
be derived from a weighted average of the beacon and
radar report position estimates.   Radar/beacon
correlation shall first be attempted prior to track
correlation.   Beacon reports which fail correlation on
ths first attempt shall be subject tc another attempt
at radar correlation within the track correlation
logic.

A radar target report may be declared before its beacon
correlative (if it exists) or vice versa for some
sensors (e.g., DABS).   For that reason some radar
reports shall be held in the radar report store and
some beacon reports shall be held in the beacon report
store throughout additional processing cycles to assure
that all report pairs that qualify are correlated.
These additional cycles shall not exceed the expected
time required to complete the correlative reports (a
system parameter).   If correlation has not been
achieved in this time interval, the reports shall be
inserted into the apprcpriate report stcre as a radar
cnly target or as a beacon only target.

3.6.2.1.1.1.5 Radar/Beacon Tracking - The Beacon
Tracking Level **(BTL) ARTS** III tracker shall be modified
to include the features described in the following
sections.   Among the added features shall be the
capability of automatically initiating and terminating
tracks on all aircraft within the ASR surveillance
areas.   In addition, modification to the correlation
logic shall provide for the combination of radar and
beacon reports from the same aircraft, improved cross

referencing, deviation scoring, and improved turning
track correlation. To improve tracking on turns the
smoothing algorithm shall be modified to provide the
capability for applying different smoothing criteria
along and across the direction of track motion. The
selection of smoothing parameters shall be made more
adaptive. For primary targets a tracking feedback loop
shall be established to improve the target detection
sensitivity in the areas of predicted track position.

3.6.2.1.1.1.5.1 Automatic Track Initiation - An
algorithm shall be provided to initiate tracks
automatically on all radar and/or beacon target
reports. The automatic initiation logic shall apply a
different scan-to-scan correlation criteria for radar
reports, beacon reports with radar reinforcement, and
beacon reports without radar reinforcement. The
automatic initiation logic shall provide for the
filtering of radar clutter and beacon fruit through the
use of speed, direction, and run length criteria.
Tracks will not be initiated on primary only target
reports which occur in areas defined as heavy clutter
by the clutter mapping, function.

3.6.2.1.1.1.5.2 Termination of Controlled Track Status
- When a controlled track status is automatically or
manually changed to uncontrolled (e.g., via the
geography dependent feature of the tracker, or the
track suspend or track drop keyboard entry) the
appropriate uncontrolled track symbol shall be
immediately associated with and displayed for that
track. In addition, a velocity criteria shall be
provided which shall automatically terminate a
controlled track (change from controlled to
uncontrolled status) when its velocity is not within
parametric (site parameter) values.

3.6.2.1.1.1.5.3 Smoothing Improvement - The BTL ARTS
III smoothing (correction) algorithm shall be modified
to include the use of track- oriented smoothing (TOS).
TOS involves the rotation of the X-Y coordinate system
to correspond with the direction of track motion prior
to computing smoothed track position. The use of TOS
adds the capability of using different alpha-beta
smoothing parameters along the across track direction.

referencing, deviation scoring, and improved turning track correlation. To improve tracking on turns the smoothing algorithm shall be modified to provide the capability for applying different smoothing criteria along and across the direction of track motion. The selection of smoothing parameters shall be made more adaptive. For primary targets a tracking feedback loop shall be established to improve the target detection sensitivity in the areas of predicted track position.

3.6.2.1.1.1.5.1 Automatic Track Initiation - An algorithm shall be provided to initiate tracks automatically on all radar and/or beacon target reports. The automatic initiation logic shall apply a different scan-to-scan correlation criteria for radar reports, beacon reports with radar reinforcement, and beacon reports without radar reinforcement. The automatic initiation logic shall provide for the filtering of radar clutter and beacon fruit through the use of speed, direction, and run length criteria. Tracks will not be initiated on primary only target reports which occur in areas defined as heavy clutter by the clutter mapping, function.

3.6.2.1.1.1.5.2 Termination of Controlled Track Status - When a controlled track status is automatically or manually changed to uncontrolled (e.g., via the geography dependent feature of the tracker, or the track suspend or track drop keyboard entry) the appropriate uncontrolled track symbol shall be immediately associated with and displayed for that track. In addition, a velocity criteria shall be provided which shall automatically terminate a controlled track (change from controlled to uncontrolled status) when its velocity is not within parametric (site parameter) values.

3.6.2.1.1.1.5.3 Smoothing Improvement - The BTL ARTS III smoothing (correction) algorithm shall be modified to include the use of track- oriented smoothing (TOS). TOS involves the rotation of the X-Y coordinate system to correspond with the direction of track motion prior to computing smoothed track position. The use of TOS adds the capability of using different alpha-beta smoothing parameters along the across track direction.

in size.

3.6.2.1.1.1.5.8 Deviation Scoring - In the case
wherein more than one report is in a track's primary
bin each with equal qualifying scores and none of these
reports is associated with another track, deviation
scoring shall be attempted to resolve the ambiguity.
The deviation score is arrived at by computing the
distance between each report position and the track
predicted position, taking into account the relative
errors in range and azimuth. The report with lowest
score (smallest error-weighted distance) is correlated
to the track.

3.6.2.1.1.1.5.9 Minimum Safe Altitude Warning **(MSAW)** -
The Radar/Beacon tracking program shall also provide
for the requirements of the MSAW program as implemented
in ARTS III version **A0.12.**

3.6.2.1.1.1.6 Keyboard Input Processing - Keyboard
data shall be input to the ARTS **IIIA** operational
program from each Data Entry Display System **(DEDS).**
The input data from each **DEDS** shall consist of one Type
1 word (display console settings: range scale and
off-centering) and three Type II words (keyboard data:
quick look selection, trackball coordinate changes, and
data/function characters).

The Keyboard Input Processing program shall process all
DEDS channel interrupts, preview all input messages,
and process all operational function requests.
Operational function requests relate to track control,
flight data, display control, system parameters, system
configuration, implied functions and enhanced target
generation.

Keyboard input processing shall be as per **NAS-MD-608**
with the following added messages:

    (a)   To control the Continuous and the Enhanced
           Target Generator.

    (b)   Messages shall be added to enable system
           configuration, initiate recovery sequence,
           load backup and standby programs and enable

or disable the overload sensing and
protection function.

(c)   To control the RDAS analog output.

(d)   The current ARTS III keyboard functions of
START TRAcK and DROP TRACK shall be changed
in concept because all targets shall be
tracked, However, the software functions to
initiate and associate flight data with a
displayed target or drop it shall remain the
same. The contractor shall make the
necessary documentation changes and procure
the necessary key covers to denote these
functions as Initiate Control **(IC)** and
Terminate Control **(TC)**.

3.6.2.1.1.1.7 Display Output Processing – The Display
Output Processing function involves the preparation and
transfer of data to the display buffer memory and the
maintenance of the buffer memory P-stack (up to **64**
words per display). The P-stack controls the transfer
of data from the buffer memory to the display
(refresh). The display output tasks shall be divided
into separate subroutines in order to effectively
handle the variety of data to be presented and to meet
the individual update frequencies required for the
various data.

The data to be transferred to each display may be
divided into eight separate categories:

1.   Active controlled aircraft (two or three line
FDB or single symbol)

2.   Inactive controlled aircraft (tabular lists)

3.   Uncontrolled aircraft **(LDB** or single symbol)

4.   System data (alphanumeric)

5.   Keyboard Preview and Readout data
(alphanumeric)

6.   Trackball position (symbol)

or disable the overload sensing and
protection function.

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3. Uncontrolled aircraft **(LDB** or single symbol)

4. System data (alphanumeric)

5. Keyboard Preview and Readout data
(alphanumeric)

6. Trackball position (symbol)

(scheduled) aircraft.   The **FP** input capability shall be an independent operational function, with on-line operator control.   The magnetic tape input may be used in conjunction with or without interfacility **(ARTCC)** communication.

A capability to load the **FP** data, prestored on magnetic tape in time-ordered sequence, into disc storage shall be provided.   The data shall then be taken from its storage element (tape or disc) validated, formatted, and processed per **NAS-MD-611.**

3.6.2.1.1.1.11   Continuous Data **Recording** - The Continuous Data Recording program shall extract radar, beacon and other data during execution of the operational program and transfer **all or** part of that data to an external storage device.   The data shall be extracted and recorded continuously.   The stored data shall be capable of being edited, reduced, and **anlayzed** by an off-line editor (see section **3.6.2.2.4).**

In addition, a capability shall exist to extract radar target data and/or beacon target data either at the input or output of the radar/beacon correlation function.   Thus, extraction of all radar-detected targets, radar-only targets, unreinforced beacon targets and reinforced beacon targets shall be ·**possible.**

Continuous data recording shall function as described in sections **3.6.1.1** through **3.6.1.2.1.2** except that radar replies and radar targets shall also be extracted.   Filter characteristics described in section **3.6.1.1.1.2** shall apply to primary (search) data where applicable and primary (search) only shall be added as a filter item.

3.6.2.1.1.1.12   Timeout Processing - System Timeout Processing consists of unrelated time tasks which must be periodically executed under executive control. These tasks include but are not necessarily limited to:

    (a)   Timeout I/O activity on all of the **DEDS** channels

(scheduled) aircraft. The **FP** input capability shall be
an independent operational function, with on-line
operator control. The magnetic tape input may be used
in conjunction with or without interfacility **(ARTCC)**
communication.

A capability to load the **FP** data, prestored on magnetic
tape in time-ordered sequence, into disc storage shall
be provided. The data shall then be taken from its
storage element (tape or disc) validated, formatted,
and processed per **NAS-MD-611.**

3.6.2.1.1.1.11 Continuous Data **Recording** - The
Continuous Data Recording program shall extract radar,
beacon and other data during execution of the
operational program and transfer **all or** part of that
data to an external storage device. The data shall be
extracted and recorded continuously. The stored data
shall be capable of being edited, reduced, and **anlayzed**
by an off-line editor (see section **3.6.2.2.4).**

In addition, a capability shall exist to extract radar
target data and/or beacon target data either at the
input or output of the radar/beacon correlation
function. Thus, extraction of all radar-detected
targets, radar-only targets, unreinforced beacon
targets and reinforced beacon targets shall be
possible.

Continuous data recording shall function as described
in sections **3.6.1.1** through **3.6.1.2.1.2** except that
radar replies and radar targets shall also be
extracted. Filter characteristics described in section
3.6.1.1.1.2 shall apply to primary (search) data where
applicable and primary (search) only shall be added as
a filter item.

3.6.2.1.1.1.12 Timeout Processing - System Timeout
Processing consists of unrelated time tasks which must
be periodically executed under executive control.
These tasks include but are not necessarily limited to:

    (a)   Timeout I/O activity on all of the **DEDS**
           channels

task.   This routine shall check to see if any thread
changes have been requested.   When a thread change
request is detected, this routine shall then determine
which of the threads to update and then update that
thread.

3.6.2.1.1.1.14 Output Message Processing - This task
supports other tasks by transferring messages generated
throughout the system to an output device.   These
messages are of three types:

> **(a)**   Recording (hardcopy) of significant system
>   changes.
>
> **(b)**   Internal error or alarm messages.
>
> **(c)**   Configuration status request messages.

This task shall be as per NAS-MD-612 with the addition
of:

> **(a)**   Internal error or alarm messages for new
>   subsysems (e.g., RDAS, CDR) and functions
>   (see para. 3.6.1.1.4).
>
> **(b)**   System configuration messages that include
>   equipment configuraticn as well as display
>   position configuration.
>
> **(c)**   Output shall normally be to TTY.   The MSP
>   shall be used as a backup to TTY.

3.6.2.1.1.1.15 Critical Data - As part of the system
recovery sequence a capability shall exist to restore
the system to the air traffic and control situation
which existed at the time the system entered the
recovery mode.

When the system is restored by a restart using critical
data, all FDBs shall be forced into the coast list, not
timed out.   FDBs in handoff status shall be handled in
the following manner:

> **(a)**   Clear all bits indicating that the FDB is in
>   handoff status.

task.   This routine shall check to see if any thread
changes have been requested.   When a thread change
request is detected, this routine shall then determine
which of the threads to update and then update that
thread.

3.6.2.1.1.1.14 Output Message Processing - This task
supports other tasks by transferring messages generated
throughout the system to an output device.   These
messages are of three types:

> **(a)** Recording (hardcopy) of significant system
> changes.

> **(b)** Internal error or alarm messages.

> **(c)** Configuration status request messages.

This task shall be as per NAS-MD-612 with the addition
of:

> **(a)** Internal error or alarm messages for new
> subsysems (e.g., RDAS, CDR) and functions
> (see para. 3.6.1.1.4).

> **(b)** System configuration messages that include
> equipment configuraticn as well as display
> position configuration.

> **(c)** Output shall normally be to TTY.   The MSP
> shall be used as a backup to TTY.

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recovery sequence a capability shall exist to restore
the system to the air traffic and control situation
which existed at the time the system entered the
recovery mode.

When the system is restored by a restart using critical
data, all FDBs shall be forced into the coast list, not
timed out.   FDBs in handoff status shall be handled in
the following manner:

> **(a)** Clear all bits indicating that the FDB is in
> handoff status.

shall consist of, but not be limited to, the following:

(a) Radar/Beacon Target Store

(b) Beacon Report Store

(c) Radar Report Store

(d) Central Track Store

(e) Track Present Nap

(f) Radar Detection Map

(g) Console Typewriter Print Request Tables

(h) Display/Keyboard Parameter Tables

(i) Configuration Tables

(j) Common Active Track Buffer

(k) Selected Code Table

(l) Tabular Track Index

(m) Track Number Pointer Table

(n) Temporary Flight Plan Store

(o) VFR/IFR Code Table

(p) Time, Altimeter Setting and ATIS/GSI

(q) Emergency/Radio Failure/Hijack/Suspect
     Aircraft

(r) Memory Readout

(s) MSAW Geography

3.6.2.1. 1. 1.18 Minimum Safe Altitude Warning (MSAW) -
The contractor shall furnish within the operational
program MSAW software as functionally specified in
PX-11325, and any revisions thereto and as functionally

updated in mutually agreed upon FAA operational
software. The MSAW aural alarm shall operate in the
multiprocessing system under normal operational
conditions as well as first level backup.

3.6.2.1.1.2 First Backup Single RT & BTL Operational
Program - The First Backup Single RT & BTL Operational
Program shall operate when the equipment configuration
is degraded by **1 IOP** and/or **1** MM. Use of this program
shall be independent of the particular IOPs and MMs
available for program execution. It shall be composed
of the same capabilities as the Single Full Capability
RT & BTL Operational Program (see section **3.6.2.1.1.1)**
except for the elimination of the search radar related
functions, all on-call programs (e.g., ETG, utility),
magnetic tape flight plan processing and the automatic
initiation of those tracks without discrete beacon
identity codes. In addition, restrict the number of
controlled tracks to **130** actively tracked tracks. The
total number of tracks (including tabular tracks) does
not change. Thus, Radar Input Processing (section
3.6.2.1.1.1.3) and Radar/Beacon Correlation (section
3.6.2.1.1.4) will not be part of the First Backup
Single RT & BTL Operational Program and radar tracking
in the Radar/Beacon Tracking (section **3.6.2.1.1.1.5)**
task will not be used. The on-call programs, and the
automatic initiation function for the remaining beacon
portion of the eliminated sensor will not be part of
the first level backup program.

3.6.2.1.1.3 second Backup Single RT & BTL Operational
Program - The second Backup Single RT & BTL Operational
Program shall be an emergency backup to be used only in
unusual circumstances. **This program** shall be a subset
of the First Backup Program. Functions shall be
deleted to allow some air traffic-control capability in
the minimum configuration possible. This minimum
configuration shall contain **1 IOP** and 3 **MMs.** The
following functional items may be deleted from the list
in section **3.6.2.1.1.1** (in order of increasing
priority): **b, c,** the radar portion of d, o, g, i, n,
j, p, q, and r. Reduced display or track capacity may
be allowed if required. The contractor shall submit a
proposed functional definition for this emergency
backup program for government review following a sizing

updated in mutually agreed upon FAA operational
software. The MSAW aural alarm shall operate in the
multiprocessing system under normal operational
conditions as well as first level backup.

3.6.2.1.1.2 First Backup Single RT & BTL Operational
Program - The First Backup Single RT & BTL Operational
Program shall operate when the equipment configuration
is degraded by 1 IOP and/or 1 MM. Use of this program
shall be independent of the particular IOPs and MMs
available for program execution. It shall be composed
of the same capabilities as the Single Full Capability
RT & BTL Operational Program (see section 3.6.2.1.1.1)
except for the elimination of the search radar related
functions, all on-call programs (e.g., ETG, utility),
magnetic tape flight plan processing and the automatic
initiation of those tracks without discrete beacon
identity codes. In addition, restrict the number of
controlled tracks to 130 actively tracked tracks. The
total number of tracks (including tabular tracks) does
not change. Thus, Radar Input Processing (section
3.6.2.1.1.1.3) and Radar/Beacon Correlation (section
3.6.2.1.1.4) will not be part of the First Backup
Single RT & BTL Operational Program and radar tracking
in the Radar/Beacon Tracking (section 3.6.2.1.1.1.5)
task will not be used. The on-call programs, and the
automatic initiation function for the remaining beacon
portion of the eliminated sensor will not be part of
the first level backup program.

3.6.2.1.1.3 second Backup Single RT & BTL Operational
Program - The second Backup Single RT & BTL Operational
Program shall be an emergency backup to be used only in
unusual circumstances. This program shall be a subset
of the First Backup Program. Functions shall be
deleted to allow some air traffic-control capability in
the minimum configuration possible. This minimum
configuration shall contain 1 IOP and 3 MMs. The
following functional items may be deleted from the list
in section 3.6.2.1.1.1 (in order of increasing
priority): b, c, the radar portion of d, o, g, i, n,
j, p, q, and r. Reduced display or track capacity may
be allowed if required. The contractor shall submit a
proposed functional definition for this emergency
backup program for government review following a sizing

Program - The First Backup Dual RT & BTL Operational
Program shall be loaded into main memory-and assume
control of the system whenever the available equipment
configuration allows if the available equipment cannot
support the Full Capability Program. Normal
configuration for the first is one IOP and one MM less
than the full capability.

Use of this program shall be independent of the
particular IOPs and MMs available for program
execution. This program shall be composed of the same
capabilities as the Full Capability Dual RT & BTL
Operational Program (see section 3.6.2.1.2.1) except
for the elimination of the radar related functions for
one sensor. Thus Radar Input Processing (section
3.6.2.1.1.1.3), and Radar/Beacon Correlation (section
3.6.2.1.1.1.4) shall not be part of the First Backup
Dual RT & BTL Operational Program and radar tracking in
the Radar/ Beacon Tracking (section 3.6.2.1.1.1.4) task
shall not be used for one sensor. The sensor to be
excluded shall be determined by the site adaptation
data base unless the available equipment forces the
choice of sensor.

3.6.2.1.2.3 Second Backup Dual RT & BTL Operational
Program - The second Backup Dual RT & BTL Operational
Program shall be similar to the Second Backup Single RT
& BTL Operational Program (section 3.6.2.1.1.3).

3.6.2.2 RT & BTL Support Software - ARTS III support
software shall be modified and expanded consistent with
the ARTS IIIA system environment. Support software
shall provide for semi-automated support functions just
as the operational software provides for semi-automated
operational functions.

3.6.2.2.1 Assembler - An assembler shall be provided
for the system described herein. The assembler shall
provide all the capabilities of the existing ARTS III
Assembler, as described in PX-6196, and the
capabilities prescribed in section 3.6.2.2.1.1 through
3.6.2.2.1.2.

3.6.2.2.1.1 Modified IOP - The assembler shall produce
object code for an IOP containing the modifications

specified in **3.5.2.10,** as well as for an unmodified
IOP. The assembler shall be augmented to generate new
instructions and exploit the added **IOP** capabilities. A
capability to assemble the largest operational program
on-line in a mode not lower than the first back-up
shall be provided.

3.6.2.2.1.2 Program Generation System - The assembler
shall be an integral part of the support software
system and shall operate on a program generation system
configuration.   As a minimum it shall consist of:

(a)   One **IOP**

(b)   Two **16K** Memory Modules

(c)   One Peripheral Adapter Module with **IMT** and
TTY

(d)   One UNIVAC **9300**

(e)   Four **UNISERVO** VI-C magnetic tape units.

(f)   A **100** megabyte disc

3.6.2.2.2 Builder - The builder shall provide the
capability of loading and linking all the executive
modules, tasks, and data bases   that make up a unique
system program.   The builder shall be physically
segmented into two sections.   The first section shall
be generated in **IMT** bootstrap format and shall include
a relative loader, a control routine, an I/O handler
for a UNIVAC VI-C Magnetic Tape Subsystem, **ASR-37**
Teletype, **100 megabtye** disc, and UNIVAC **9300** (high
speed printer and card reader).   The second section
shall be generated in' relocatable format acceptable for
loading by the relative loader.   The builder shall be
executed in a one **IOP** configuration and shall,
therefore, not need to be coded reentrant.   The builder
shall require **nc** more than two memory modules and the
use of disc.

3.6.2.2.3 Builder Utility Program (SUP) - The **BUP**
shall provide a convenient, efficient means of
building, modifying, and inspecting an organized set of

specified in **3.5.2.10,** as well as for an unmodified
IOP. The assembler shall be augmented to generate new
instructions and exploit the added **IOP** capabilities. A
capability to assemble the largest operational program
on-line in a mode not lower than the first back-up
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shall require **nc** more than two memory modules and the
use of disc.

3.6.2.2.3 Builder Utility Program (SUP) - The **BUP**
shall provide a convenient, efficient means of
building, modifying, and inspecting an organized set of

always be the third record. System programs and
diagnostic/utility programs shall start with the fourth
record.

3.6.2.2.4 Continuous Data Recording (CDR) Editor - The
CDR editor shall provide printer output of the data
written by the CDR extractor (see section
3.6.2.1.1.1.11). The CDR editor shall be capable of
operating in any IOP which is physically cabled to the
CDR peripherals and with any 16K memory module.

The operator shall have control of the data types and
data filters. Data type indicators and filter values
shall be input by the operator. It shall function as
described in section 3.6.1.2.1 except that search radar
replies and search radar targets are allowable data
types and the output filters shall include search
radar.

3.6.2.2.5 Diagnostic Software

3.6.2.2.5.1 Systems Diagnostics - A system
diagnostic/monitor test shall be supplied for the RT &
BTL systems. The purpose of the system
diagnostic/monitor shall be to (a) ascertain the
operability of equipment functions associated with the
systems and (b) provide a maintenance tool which has
the capability of exercising the system to nearly the
same degree as the operational program and to isolate
problems which may occur under this level of exercise.

The system diagnostic shall be modular in nature. That
is any combination of subprograms can be added to
achieve the degree of system verification desired. As
a minimum the system diagnostic program shall be
comprised of the following test subprograms:

    (a)   Diagnostic Monitor Subprogram

    (b)   Processor Subprogram

    (c)   Memory Unit Subprogram

    (d)   Data Entry and Display Subprogram

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diagnostic/utility programs shall start with the fourth
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comprised of the following test subprograms:

     (a)   Diagnostic Monitor Subprogram

     (b)   Processor Subprogram

     (c)   Memory Unit Subprogram

     (d)   Data Entry and Display Subprogram

The diagnostics shall provide the complete capability
of testing, monitoring, and evaluating all
logical/programmable functions within the module under
test.   The diagnostics shall detect 95 percent of all
single, non-intermittent Printed Circuit Board **(PCB)**
failures and provide **isclation** of 75 percent of those
malfunctions to an average of three printed circuit
cards of any type.   (This assumes a **PCB** size of 3
inches by 4 inches.   For larger **PCBs,** isolation shall
be to a single **PCB.**)   I& equipments where cards are not
employed, malfunctions shall be isolated to a group of.
replaceable circuit elements equivalent to the logic
contained on three average printed circuit cards.   This
isolation shall be accomplished using a combination of
automatic and manual procedures.

A capability for manual call up of diagnostics shall be
provided to be used in an off-line mode.   This means
that no operations shall occur in the module under test
at the time the module diagnostic is being executed.
Each program shall assume that all modules necessary
for test use, **except** the module under test, are in
proper operating order.   All execution of these
diagnostics shall be from the appropriate **IOPs**
indicator panel.   The manual call diagnostics shall be
manually loaded from magnetic tapes.

3.6.2.2.6 Debug Aids - The debug aids are programs
which may be used in the program development and
program maintenance efforts to assist in the isolation
of program related problems.   The debug module is a
removable part of the executive program.   The other
debug aids described below are self contained programs
which may be loaded with the operational program.

3.6.2.2.6.1 Debug Module - The debug module shall be a
removable segment of the executive program intended for
use at a support facility.   The debug module provides
the programmer with the tools for the integration and
checkout of a program task.   The debug module shall
provide the following functions:

    (a)   Software Breakpoint - This function shall
        enable or disable a breakpoint operation.
        When a processor reaches a software

breakpoint, the processor shall be placed in
a suspended state. It shall be possible to
request any debug function following a
breakpoint hit.

(b) Program Segment Timing - This function shall
determine the elapsed **time** between the
execution of two specified timing breakpoints
and provide output timing statistics on the
printer.

(c) Snap Dump - This function shall output
immediately the contents of a limited area of
memory whenever a processor reaches a
specified memory address. Output shall be
routed.to printer, teletype or magnetic tape.

(d) Change Memory - This function shall change
the content of a specified memory word to the
data value specified by the user. The **old**
and new data values shall be printed
following the change.

(e) Dump Memory - This function shall search a
specified area of memory for a selected bit
configuration and print the address of each
find.

(f) Suspend Processor - This function shall cause
the requested processor(s) to enter a
suspended state with task processing
discontinued. A suspended processor shall
remain available for processing of other
debug requests. A suspended processor shall
resume processing upon command.

(h) Register **Dump** - This function shall output
the content of pertinent registers at a
selected breakpoint.

(i) Processor History - This function shall
collect and print history data including
executive service requests, interprocessor
interrupt type executed, planned tasks
executed, popup tasks executed, processor

breakpoint, the processor shall be placed in
a suspended state. It shall be possible to
request any debug function following a
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determine the elapsed **time** between the
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(i)   Processor History - This function shall
collect and print history data including
executive service requests, interprocessor
interrupt type executed, planned tasks
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designed to be maintained with a minimum of external test equipment and use of standard hand tools. Corrective maintenance shall be effected by replacement of defective module(s) with subsequent repair of the defective module(s) off-line. Requirements for adjustments shall be kept to a minimum. The design, to the maximum extent possible, shall maximize interchangeability, minimize the need for adjustment and attempt to limit the variety of modules, and PC boards, used in the system.

3.8.1 Applicable Definitions - The reliability, availability and maintainability definitions used in this specification are those of MIL-STD-721, with the additions or modifications as noted below:

(a) Mean-Time-to-Repair (MTTR) - The mean-time-to-restore to an operational condition a function or equipment that has failed. The function or equipment may be restorable by corrective maintenance repair, substitution by module or PC board replacement.

(b) Availability - The probability of specified operability at any time over the service life of the system. Allowed preventative maintenance times need not be counted as unavailable periods or down-time, provided the requirement to reach an operable state as defined herein is always met. Availability is the quotient of the total system up-time divided by the sum of the total system up-time and down-time.

(c) Service Life - Intended useful life of system. Short life items are replaced on a scheduled basis under the preventative maintenance plan. For the ARTS IIIA System, the service life is at least ten (10) years.

(d) Module - That component part, assembly or element as defined by the contractor and approved by the government and designated as the first level of maintenance required to

repair or restore the system function to
normal and provide the service intended.

3.8.2 System Failures - ARTS **IIIA** System failures fall
. into two categories, functional failures and equipment
failures. Both categories can be chargeable as
downtime in determination of system availability,
system **MTBF,** or both.

3.8.2.1 Functional Failures **-** Functional failures are
those failures which: **(1)** cause either the complete
or partial loss of a functional capability required by
this specification; **(2)** cause degraded operation of a
function by deviating from the performance requirements
of **3.10;** or **(3)** cause the erratic, erroneous,
transient or unintended operation of any function. A
functional failure shall not be declared during a
normal **10** second recovery operation.

3.8.2.2 Equipment Failures **-** Equipment failures are
rack, drawer, module, card, or **part** failures whose
impact upon the system functions may vary from a minor
maintenance action to catastrophic. For example, the
failure of a **BDAS** whose redundant unit takes over
automatically, with no loss of a function, is only an
equipment failure and does not impact on system
availability. However, the random or catastrophic
failure of a module that effects the data presented at
cne or more displays is both an equipment and.
functional failure, and therefore impacts on system
availability.

3.8.3 Reliability and Maintainability **(R & M)** Program

3.8.3.1 Program Plan **-** The contractor shall prepare
and submit for approval a R & M program plan in
accordance with **MIL-STD-785.** This program plan shall
be submitted with the technical proposal and updated
within sixty **(60)** days after **award of** contract. This
program plan shall include software reliability.

3.8.3.2 R & M Management **-** The contractor shall have
one clearly identified organizational element which
will be responsible for the planning and management of
the R & M program specified herein and for insuring its

repair or restore the system function to
normal and provide the service intended.

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will be responsible for the planning and management of
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3.8.3.3.3 R & M Modeling Task - The ARTS **IIIA** System shall be reliability and maintainability modeled. The contractor shall identify critical items or paths whose failure will either cause system or subsystem failures, major performance degradation, loss of a function, marginal operational conditions or departures from the R & M Requirements, as specified herein. From the R & M predictions and the R & M models, together with system operational loading, critical elements shall be highlighted with emphasis upon means of sustaining operation, via techniques such as redundancy, manual patches, and over-capacity, in the event of failure. Note, however, that the ability to sustain or reinstate operation in this manner shall not prevent the incident from being classified as a failure. Preliminary estimates for each of the models shall be submitted with the proposal and shall be updated as necessary to reflect system changes as they may occur. A final version containing all system details shall be submitted and included as part of the critical design review data package, and shall be subject to the review cycle as specified. The R & M Modeling shall include the following three **(3)** configurations:

    (a)   The Mass Storage Subsystem **(MSS)** of a **BTL** system.

    (b)   Radar Tracking and Beacon Tracking Level **(RT & BTL)** system with **MSS** using a single and dual radar and beacon sensor input.

    (c)   Beacon Tracking Level of a **RT & BTL** system.

3.8.3.3.4 Failure Modes, Effects and Criticality Analysis **(FMECA)** Tasks - A **FMECA** shall be performed. This analysis shall be conducted down to the level of modular replacement in normal maintenance (e.g., printed circuit card, power supply module). For each such replaceable item, the dominant modes of failure shall be determined. Based upon these modes of failure, the effect on subsystem and system performance shall be ascertained. The analysis results shall be employed to evaluate and change the reliability maintainability-availability **(RMA)** model, if necessary. The task shall be completed and reviewed at the

critical design review and used' in preparation of the maintainability demonstration tasks. A preliminary analysis utilizing the reliability model shall also be submitted ninety **(90)** days after contract award and updated thereafter as design or system changes occur. The **FMECA** will be reviewed as part of each design review. Any further changes in the **FMECA** shall be submitted at least sixty **(60)** days prior to initiation of the reliability or maintainability demonstrations specified in Section **4.0.**

3.8.3.3.5 Parts Control Task - The contractor shall establish a parts control effort that shall, to the maximum extent possible: (a) assure the utilization of standard parts or assure proper **useage** application **cf** commercially available off-the-shelf equipment permitted by **FAA-E-2591a; (b)** assure the suitability of nonstandard parts that 'are subject to Government approval prior to being incorporated in the system design.

3.8.3.3.6 Failure Reporting, Analysis and Corrective Action Task - The contractor shall establish 'a closed loop system for reporting all **failures.** The level of equipment (e.g., circuit board or module) both manufactured and subcontracted items, for which the contractor proposes to maintain failure records shall be included in the technical proposal. As a minimum, failures occurring from the time of final manufacturing unit test forward to the end of the warranty period shall be reported with analysis and results. Analysis and results **cf** failures will not be required on commercially available off-the-shelf equipment. The contractor shall analyze each failure to determine its cause.   Each analysis shall include development of corrective action to prevent reoccurrence. Failure reports shall be maintained by the contractor to which the Government will have unlimited access. A copy of any individual report shall be provided to the Government on request. Off-the-shelf item failures shall be handled on an as required basis. Whenever a significant problem becomes evident, the analysis and corrective action of that problem shall be made.

3.8.3.3.7 Reliability and Maintainability

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3.8.3.3.7 Reliability and Maintainability

(b) Transients that cause the line voltage to increase to **more** than **110** percent of nominal but less than **130** percent when the transient is **17** milliseconds or less in duration.

(c) Transients that cause the line voltage **to** vary by plus or minus **10** percent from nominal for any duration of time.

(All reference to line voltage is line to neutral)

An interruption (AC voltage has gone outside the range of **90** to **110** percent of nominal) may start at any time during a **60-cycle** period with the requirements above still applicable.

3.8.4.3 System Maintainability - Design of the hardware and software shall provide a system capable of having faults isolated to the correct unit in an average of not more than five minutes. The contractor shall discuss in the proposal the maintenance 'concept, tailored to **MIL-STD-470,** and include the following system maintenance parameters:

(a) Cost tradeoffs and reliability considerations involved in the application of both preventive and corrective maintenance.

(b) Number and skill level of maintenance personnel and type of specialized training required to maintain the system.

(c) Level of the diagnostic support.

(d) Type of printed circuit board malfunction isolation and repair technique.

(e) On-line system performance monitoring.

3.8.4.4 Maintenance Concept - The maintenance concept shall be to localize a failure through use of system monitoring features, and software and hardware maintenance features and to replace the failed module elements or pluggable **unit** from site spares. The actual repair of the defective or failed item shall be

accomplished off-line at the convenience of maintenance personnel.'

3.8.4.5 Subsystems Isolation - System design shall be such that component failure within **any subsystem** shall not' cause equipment or functional failure in another -subsystem.   As an example, the Continuous Data Recording **(CDR)** function is defined as a subsystem; any functional or equipment failure occurring within the **CDR** subsystem shall' not affect the functional capability of other subsystems.

3.8.4.6 Modification of Basic ARTS III **GFE** Equipment **or** Subsystems - Modifications to existing **GFE** equipment or subsystems that are required by the **contractor's** design to meet the ARTS **IIIA** System requirements **specified** herein shall in no way degrade performance or reliability of modules or components within the subsystems that are not modified by the contractor.

3.8.5 System Reliability Parameters - The ARTS **IIIA** System shall meet the reliability, maintainability and availability (RNA) specified herein when operated in a **90** degree Fahrenheit environment.   Incandescent   lamp failures may be **exluded** in determining system **MTBF's,** however, panel lamps shall be replaceable from the front of equipment cabinets without need of special **tools.** Generalized functional models of the typical' subsystems of the ARTS **IIIA** System configuration are shown in Figures **3-1, 3-2,** and **3-3.**   These figures are included here for information purposes only.

3.8.5.1 System Availability

3.8.5.1.1 RT & BTL Capability - The availability of the **RT & BTL** capability shall not be less than **0.999** with a **M.U.T.** of at **least 770** hours.   The **RT & BTL** capability is considered available if not more than 2 simultaneous **DEDS** failures have occurred.   The Continuous Data Recording Function is not required.

3.8.5.1.2 BTL Capability - The **RT & BTL** system shall be designed such that in **the** event of a single equipment module failure the system can be manually reconfigured to provide a **BTL** capability that is

accomplished off-line at the convenience of maintenance
personnel.'

3.8.4.5 Subsystems Isolation - System design shall be
such that component failure within **any subsystem** shall
not' cause equipment or functional failure in another
-subsystem. As an example, the Continuous Data
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simultaneous **DEDS** failures have occurred. The
Continuous Data Recording Function is not required.

3.8.5.1.2 BTL Capability - The **RT & BTL** system shall
be designed such that in **the** event of a single
equipment module failure the system can be manually
reconfigured to provide a **BTL** capability that is

(a)   Intended use, such, measure voltage, or count
      pulses.

(b)   Ranges required.

(c)   Accuracy requirements.

(d)   Special parameters, such as, short term
      drift, long term stability, and temperature
      requirements.

(e)   At least three suggested sources of supply.

(f)   Estimated cost (catalog prices) for single
      units and quantities.

(g)   Estimated frequency of use.

3.10 System Performance Requirements

3.10.1   General - The system shall meet all the
performance requirements in this section simultaneously
when perforing the operational functions required by
this specification.   These performance requirements
shall be satisfied when operating under the traffic
loads and environmental conditions specified in the
contract.   Adherence to the performance requirements
shall be measured in the tests described in section 4.
Performance requirements are defined for the following
functional areas:

1.   Target detection/declaration

2.   Tracking

3.   System throughput/response

4.   Continuous data recording

5.   Display data

6.   Failure recovery/system reconfiguration

3.10.2 Radar Target Detection - The target detection
function shall meet, and be tested to, the following

performance criteria.

3.10.2.1 Final Detection Performance - The detection window used in the final detection process shall sample the returns received at the same 1/16 N.M. range cell for as many sweeps as contained in the beamwidth of the antenna pattern of each radar. The sample size **(sweep/beamwidth)** shall be a parameter between 8 and 48 and be set for each site. The false alarms generated **by** radar noise input to the window **(no clutter,** no targets) shall conform (±10%) to equation:

$$P_{FA} = P_N(1 - P_N) \left[\frac{(N - 1)!}{(T_L - 1)!(N - T_L)!} \right] P_N^{(T_L - 1)} (1 - P_N)^{(N - T_L)}$$

Where N = sample size (sweeps per beamwidth)

P_N = probability of noise pulse in any range quantum (as defined in **FAA-E-2591a,** Paragraph **3.1.17.2.3,** Log Normal Rank Order **Quantizer)**

T_L = target leading edge threshold, which shall be a site adaptable parameter between 4 and 24

P_{FA} = probability of a false alarm.

3.10.2.2 Center Azimuth Estimation - Target center azimuth estimation shall have a standard deviation of no greater than 0.2 degrees for a target that is 6 db stronger than noise.

3.10.3 Tracking - The performance of the tracking module shall be defined and measured within two areas:

(a)   tracking capability, and

(b)   -tracking quality.

3.10.3.1 Tracking **Capabiliy** - The tracking module

performance criteria.

3.10.2.1 Final Detection Performance - The detection window used in the final detection process shall sample the returns received at the same 1/16 N.M. range cell for as many sweeps as contained in the beamwidth of the antenna pattern of each radar. The sample size (sweep/beamwidth) shall be a parameter between 8 and 48 and be set for each site. The false alarms generated by radar noise input to the window (no clutter, no targets) shall conform ($\pm 10\%$) to equation:

$$P_{FA} = P_N(1 - P_N) \left[\frac{(N - 1)!}{(T_L - 1)!(N - T_L)!} \right] P_N^{(T_L - 1)}(1 - P_N)^{(N - T_L)}$$

Where N = sample size (sweeps per beamwidth)

P_N = probability of noise pulse in any range quantum (as defined in FAA-E-2591a, Paragraph 3.1.17.2.3, Log Normal Rank Order Quantizer)

T_L = target leading edge threshold, which shall be a site adaptable parameter between 4 and 24

P_{FA} = probability of a false alarm.

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3.10.3 Tracking - The performance of the tracking module shall be defined and measured within two areas:

(a) tracking capability, and

(b) -tracking quality.

3.10.3.1 Tracking Capabiliy - The tracking module

and the range and azimuth standard deviations
are .04 nm and 0.23 degrees respectively, the
track loss probability shall be as follows
for all speeds less than or equal to 400
knots:

Discrete Beacon Aircraft: No track loss for
both straight and level flight and
non-military maneuvers.

Non-Discrete Beacon and No-Beacon Aircraft in
the clear: Less than or equal to 1% for
straight and level flight; less than or equal
to 5% for non-military maneuvers.

(c)   Track Swaps: The track swap requirements
       shall apply to a variety of maneuvers of two
       or more aircraft including shallow (less than
       or equal to 10 degrees) cross-over and
       overtake patterns. Track swaps shall include
       erroneous identity in the data block as well
       as track loss under a swap opportunity. The
       requirements shall be as follows:

       Discrete Beacon Aircraft (at least one of the
       pair): No track swaps.

       Non-Discrete Beacon and No-Beacon Aircraft
       (both aircraft): Less than or equal to 5% of
       the total of all swap opportunities.

3.10.3.2.2 Track Accuracy - The output of the tracking
module shall meet the following accuracy requirements:

(a)   Straight and level flight: For straight and
       level flight, track accuracy is expressed in
       terms of the standard deviation (sigma) of
       the error between the true value, and the
       calculated value. For the standard
       deviations given below, the aircraft slant
       range is between 15 and 50 nautical miles and
       the aircraft speed is 150 knots.

       Position Error: Less than or equal to 300

feet.

Speed Error: Less than or equal to 12 knots.

Heading Error: Less than or equal to 5 degrees.

(b)   Maneuvers (Dogleg):   For maneuvering aircraft in a standard rate turn (3 degrees/sec if speed less than 200 knots, 1/1/2 degrees/sec if speed is greater than or equal to 200 knots), track accuracy is expressed in terms of the expected value of the error between the estimated value and the true value. For maneuvers, the significant parameters are RMS errors and the time it takes for the RMS error to be reduced to the straight line error when the aircraft returns to straight line flight. For the values given below, the aircraft slant range is between 15 and 50 nautical miles, the aircraft speed is 150 knots, and the dogleg angle is 90 degrees. The requirements shall be:

		Return to Straight Line Performance
RMS Position Error:	600 feet	10 scans
RMS Speed Error:	55 knots	10 scans
RMS Heaing Error:	21 degrees	8 scans

These values apply to beacon equipped aircraft and non-beacon aircraft in the clear. The target report quality shall be as specified under Track Loss Probability in Section 3.110.3.2.1.

3.10.4 System Throughput/Response

3.10.4.1 Response to Video Signals - The time to display symbology after a video signal is received from the radar cr beacon set shall be no greater than 1.2

feet.

Speed Error: Less than or equal to 12 knots.

Heading Error: Less than or equal to 5 degrees.

(b)   Maneuvers (Dogleg):   For maneuvering aircraft in a standard rate turn (3 degrees/sec if speed less than 200 knots, 1/1/2 degrees/sec if speed is greater than or equal to 200 knots), track accuracy is expressed in terms of the expected value of the error between the estimated value and the true value. For maneuvers, the significant parameters are RMS errors and the time it takes for the RMS error to be reduced to the straight line error when the aircraft returns to straight line flight.   For the values given below, the aircraft slant range is between 15 and 50 nautical miles, the aircraft speed is 150 knots, and the dogleg angle is 90 degrees. The requirements shall be:

		Return to Straight Line Performance
RMS Position Error:	600 feet	10 scans
RMS Speed Error:	55 knots	10 scans
RMS Heaing Error:	21 degrees	8 scans

These values apply to beacon equipped aircraft and non-beacon aircraft in the clear.   The target report quality shall be as specified under Track Loss Probability in Section 3.110.3.2.1.

3.10.4 System Throughput/Response

3.10.4.1   Response to Video Signals - The time to display symbology after a video signal is received from the radar cr beacon set shall be no greater than 1.2

1. Number of true radar targets, each sensor: 30/scan

2. Number of true radar targets in one sector (11.25 degrees), each sensor: 25

3. Number of false radar targets each sensor, in addition to the number of radar targets of item 1: 50/scan

4. Number of beacon targets (all Node C) each sensor: 130/scan

5. Number of beacon targets in one sector (11.25 degrees), each sensor: 15

6. Fruit rate (undefruited input) each sensor: 2000/sec

7. Full Data Blocks each display: 20 (14 character tag)

8. Limited Data Blocks, each display: 15 (3 character tag)

9. Tabular Messages, each display: 15 (10 characters)

10. Controlled Single Symbols, each display: 100

11. Uncontrolled Single Symbols, each display: 100

12. Displays, each site: 14

13. Keyboards, each site: 34

14. The ratio of controlled to uncontrolled aircraft is 2:1

The above data shall be used as a guide for the design of the software architecture. System sizing shall be determined by environmental and traffic loads for each site whih will be defined in the contract.

1. Number of true radar targets, each sensor:
   30/scan

2. Number of true radar targets in one sector
   (11.25 degrees), each sensor: 25

3. Number of false radar targets each sensor, in
   addition to the number of radar targets of
   item 1: 50/scan

4. Number of beacon targets (all Node C) each
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   degrees), each sensor: 15

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   character tag)

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The above data shall be used as a guide for the design
of the software architecture. System sizing shall be
determined by environmental and traffic loads for each
site whih will be defined in the contract.

DATA	DISPLAY TYPE 1, II
FULL DATA BLOCKS	24
LIMITED DATA BLOCKS	100
SINGLE SYMBOLS	50
TABULAR LINES	15

FULL DATA BLOCK   CONSISTS OF TARGET SYMBOL, LEADER,
                           AND **14** CHARACTER TAG

LIMITED DATA BLOCK   CONSISTS OF TARGET SYMBOL, LEADER,
                           AND 3 CHARACTER TAG

SINGLE SYMBOL   CONSISTS OF TARGET **SYMBOLOGY**

TABULAR LINE   POSITION ADDRESS AND **10** CHARACTERS

REFRESH RATE: **24** Hz MINIMUM with ten displays on a single **IOP** being
                refreshed concurrently with the above data display
                model in the available digital refresh time.

TABLE **3.10-1**

DATA DISPLAY MODEL

DATA	DISPLAY TYPE 1, II
FULL DATA BLOCKS	24
LIMITED DATA BLOCKS	100
SINGLE SYMBOLS	50
TABULAR LINES	15

FULL DATA BLOCK   CONSISTS OF TARGET SYMBOL, LEADER, AND 14 CHARACTER TAG

LIMITED DATA BLOCK   CONSISTS OF TARGET SYMBOL, LEADER, AND 3 CHARACTER TAG

SINGLE SYMBOL   CONSISTS OF TARGET SYMBOLOGY

TABULAR LINE   POSITION ADDRESS AND 10 CHARACTERS

REFRESH RATE: 24 Hz MINIMUM with ten displays on a single IOP being refreshed concurrently with the above data display model in the available digital refresh time.

TABLE 3.10-1

DATA DISPLAY MODEL

(b)   Typical floor plan layouts' for control and
equipment rooms. Information on equipment
placement limitations, e.g., maximum
distances between equipment comprising the
system or new equipments and equipments
already in place, shall be included.

(c)   Detailed physical description of the
equipment including physical size, weight,
clearance factors, ventilation or air
conditioning requirements, cable entry and
exist features.

(d)   Cable and duct/overhead ladder requirements.
This section shall include such items as
information on subsystem cable
interconnection requirements, system cable
connections to existing equipment, type and
quantity of cables to be used.

(e)   Power requirements. Information on size and
type of power cabling to be used, type and
size of required Government furnished power
panels, shall be included.

(f)   System and equipment grounding requirements
shall be stated.

(g)   Any other technical or general information
that will be required for Government field
organizations in order to properly prepare a
site for installation activities and which
should be considered for proper installation,
operation and maintenance of the equipment.

3.11.1.2 Government Prepared Preliminary Installation
Plan - The contractor shall visit five mutually agreed
upon ARTS IIIA sites. Information gained from these
trips shall be used to assist the contractor in the
preparation of a typical site planning report. Based
on the contractor prepared typical site planning
report, the Government will prepare a site by site
preliminary installation plan and submit this to the
contractor for review. This preliminary plan will
cover such items as:

(a)   Floor plan drawings showing each piece of
       equipment in the equipment rooms and all
       signal cable ladders and/or ductwork for
       signal cables between equipments.

(b)   Cable routing diagram or cable routing
       information showing proposed 'cable routing
       and estimated length of cable runs between
       equipment.

(c)   Power distribution diagram showing the
       circuit breakers and sizes to be installed
       for each piece of equipment as specified in
       the typical site planning report.

(d)   A system grounding diagram showing the
       various ground cables that are to be
       installed and connected to the equipment as
       specified in the typical site planning
       report.

(e)   Equipment delivery information such as
       elevators, ramps, doorways, hallways, etc.

(f)   Any other general information mutually agreed
       to between the Government and the contractor.

These preliminary installation plans will be submitted
six months prior to scheduled system delivery at a
particular site to permit contractor 'review and still
allow a minimum of five months for actual site
preparation work.

Prior to actual site preparation work, the contractor
shall inspect the site and review with the designated
FAA representative all installation and site
preparation plans to ensure that it conforms with
contractor requirements. Cable length and other
necessary installation materials shall be determined by
the contractor during this site survey.

An inspection of the prepared site shall be made by the
contractor 10 days prior to equipment deivery. A
representative of the Government shall be on site at
this time. During this visit, the contractor shall

(a)   Floor plan drawings showing each piece of
      equipment in the equipment rooms and all
      signal cable ladders and/or ductwork for
      signal cables between equipments.

(b)   Cable routing diagram or cable routing
      information showing proposed 'cable routing
      and estimated length of cable runs between
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contractor 10 days prior to equipment deivery. A
representative of the Government shall be on site at
this time. During this visit, the contractor shall

(g) Site Operational System Test and Acceptance.

(h) Operational Readiness Demonstration of entire **system.**

(i) Certification of system and cutover of operational status.

3.12 Documentation - The contractor shall provide all necessary services and material to develop and deliver documentation in the quantities and at the times specified by the contract schedule.

3.12.1 System Design Data - The design data submission shall **be** organized to reflect the contractor's approach to the total system design. This submission of design data shall not be used to produce modifications or alternatives to details of this specification or a change in the scope of the contract. The design data shall include all elements of the equipment to be supplied by the contractor under the terms of the contract, as detailed by this specification and any addenda thereto, together with all interfaces with other equipment. A summary of equipment operational characteristics shall be included.

3.12.1.1 Block Diagram - A complete set of equipment block diagrams shall be provided by the contractor. The block diagrams shall show the general operational, electrical, and physical relationships of the equipment elements.

3.12.1.2 Information Logic Flow Diagrams - The contractor shall provide complete equipment information logic flow diagrams. These diagrams shall show the detailed logical, operational and functional relationships of the equipment elements. **Symbology** used in these diagrams shall be **fully** explained in the basic document.

3.12.1.3 Input/Output Details - The contractor shall provide data which consolidates all equipment interfaces and input/output characteristics. This shall include: transmission line characteristics, signal characteristics and limits, timing diagrams,

message structure and formats, and power requirements. This data shall include all major **intra-system** as well as external system interfaces.

3.12.1.4 Computer Program Design Data - A complete document of the program organization and design data, subprogram description; external data **formats,** and · internal data formats shall be furnished. This document shall provide overall information about the total computer program. The design data shall indicate the partitioning of the functional requirements into logically related subsets, which are identified with specific subprograms. For each subprogram, a **discussion** of performance requirements, including estimates of program timing and core storage requirements shall be provided..

3.12.2 Software Documentation - The contractor shall provide operational and support program coding specifications, computer **program** functional specifications and operator manuals for both the **RT &** **BTL** system and the existing **BTL** system to which **CDR** has been added.

3.12.2.1 Program coding Specifications - The program coding specifications shall include detailed descriptions of the program operations for all program and Subprogram paths, descriptions of all **tables** including 'formats, program listings and flow charts in sufficient detail to permit modifications to the program by appropriately trained Government personnel.

The coding specifications shall be supplied for the **RT & BTL system** and the **CDR** portion of the existing **BTL** system.

3.12.2.2 Computer Program Functional Specifications **(CPFS)** - The contractor shall provide a complete set of CpFSs similar in detail and content to the **CPFSs** which exist for the current **ETL** system **(NAS-MD-602** through **NAS-MD-613).** A preliminary set of **CPFSs** shall be provided at the time of submission of the system design data.

3.12.2.3 Operator Manuals - For the **RT & BTL system,**

message structure and formats, and power requirements.
This data shall include all major **intra-system** as well
as external system interfaces.

3.12.1.4 Computer Program Design Data - A complete
document of the program organization and design data,
subprogram description; external data **formats,** and ·
internal data formats shall be furnished.   This
document shall provide overall information about the
total computer program.   The design data shall indicate
the partitioning of the functional requirements into
logically related subsets, which are identified with
specific subprograms.   For each **subprogram, a**
discussion of performance requirements, including
estimates of program timing and core storage
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descriptions of the program operations for all program
and Subprogram paths, descriptions of all **tables**
including 'formats, program listings and flow charts in
sufficient detail to permit modifications to the
program by appropriately trained Government personnel.

The coding specifications shall be supplied for the **RT**
& BTL system and the **CDR** portion of the existing **BTL**
system.

3.12.2.2 Computer Program Functional Specifications
(CPFS) - The contractor shall provide a complete set of
CpFSs similar in detail and content to the **CPFSs** which
exist for the current **BTL** system **(NAS-MD-602** through
NAS-MD-613).   A preliminary set of **CPFSs** shall be
provided at the time of submission of the system design
data.

3.12.2.3 Operator Manuals - For the **RT & BTL system,**

for subsequent preparation of the test procedures.

3.12.3.1.2 lest Schedule - The test plan shall contain
a contractor proposed schedule fcr each test.   The
Government reserves the right to witness any or all
tests conducted in accordance with the approved test
plan.

3.12.3.1.3 Test Plan Amendments - If, during a test,
the test methods or parameters, as agreed to by the
Government, are found to be inadequately specified,
they shall be amended and further approval by the
Government obtained.

3.12.3.2   Test Procedures - The contractor shall
provide all test procedures and/or scripts to be used
during the conduct of a test.   These procedures shall
include all test record forms to be used as test data
sheets, test operator logs, and reports.   The test
procedures in addition shall include:

1. Designation of all inputs that are required to
   test each function.

2. Test output records including a description of
   required outputs, the types of equipment used
   to observe or provide the outputs.

3. A complete time sequenced schedule of events.

4. A list and description of each software
   program to be used, including the total
   running time for each program.   The
   description shall include the format and
   contents of each type of message output and of
   any printouts or records to be maintained.

5. A detailed description of analysis or
   combination of analysis and test results which
   may be offered in lieu of testing, where
   complete test results may be difficult or
   impractical to obtain.

These documents shall be provided by the contractor and
submitted for review 30 days prior to the scheduled

for subsequent preparation of the test procedures.

3.12.3.1.2 Test Schedule - The test plan shall contain
a contractor proposed schedule for each test. The
Government reserves the right to witness any or all
tests conducted in accordance with the approved test
plan.

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the test methods or parameters, as agreed to by the
Government, are found to be inadequately specified,
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        program to be used, including the total
        running time for each program. The
        description shall include the format and
        contents of each type of message output and of
        any printouts or records to be maintained.

    5.   A detailed description of analysis or
        combination of analysis and test results which
        may be offered in lieu of testing, where
        complete test results may be difficult or
        impractical to obtain.

These documents shall be provided by the contractor and
submitted for review 30 days prior to the scheduled

paragraph 1.3 of FAA-E-2591a. Engineering drawings
shall be in accordance with FAA-STD-002, with Amendment
1. Engineering logic diagrams shall be in accordance
with FAA-STD-010a.

3.12.6 Progress Reports - The contractor shall provide
periodic progress reports as defined and scheduled in
the contract.

4. QUALITY ASSURANCE PROVISIONS - The contractor shall
establish and maintain a quality control program in
accordance with FAA-STD-013a. The quality assurance
provisions specified in Section 1-4 of FAA-G-2100/1
form a part of this specification unless otherwise
noted. The following levels of inspection and testing
are applicable to all systems and shall be conducted in
accordance with requirements put forth in the contract.

Records of tests, including examinations and
inspections shall be kept complete and available to the
Government. All tests and inspections shall be
performed by the contractor. The Government, however,
reserves the right to witness or perform any of the
test or inspections required. The Governement reserves
the right to subject all tests and inspections to
Government approval by FAA inspectors. The Government
also reserves the right to waive the requirements of
any portion of the inspections and tests. All tests
shall be conducted in accordance with test methods and
procedures stated in the Government approved test plan.

The contractor shall be responsible for conducting all
required tests. Whenever tesing is scheduled, the
contractor shall ascertain that the test scripts and
test data sheets have been distributed, and that the
test ara has been cleared of all equipment parts, and
components, not required for the subject test. All he
test personnel shall ncrmally be provided by the
contractor. However, the FAA reserves the right to use
FAA personnel in lieu cf contractor personnel to man
any operating position in the equipment configuration
under tes. The contractor shall make any and all
additional tests necessary to demonstrate compliance to
the required system perfcrmance. If duringthe course
of any tests, errors or malfunctions occur, the

contractor shall file the appropriate forms and mak
entries in the appropriate forms and make entries in
the appropriate logs. In addition, the contractor
shall document each error or malfunction indicating the
type, the procedures taken, the time required to
correct and make the error assignment to the
appropriate equipment cr software element.

The contractor shall be responsible for incorporating
and testing any modification to his design found
necessary during the testing of the equipments. No
design changes or modifications will be allowed to the
equipment under test without the approval of the
designated FAA representative. If any changes are
found to be necessary, the Government reserves the
right to required any completed tests to be rerun to
verify that no adverse effects result from the change.
Failure during testing shall be recorded in accordance
with the Facility Outage and Equipment Failure Report
 (FAA Handbook SM P 6040.1B). Maintenance logs shall
utilize FAA Form 6030.1 and be filled out per Order SM
6030.36A.   The FAA may require the contractor to repeat
tests, or portions thereof, if the original tests fail
to demonstrate compliance with the specification.

Two major categories of tests are required: design
verification tests which are conducted on selected
units, subsystems and systems and acceptance tests
which re conducted on all units, subsystems and
systems.

4.1 Design Verification Tests - The contractor shall
conduct design tests to demonstrate that the
requirements of this specification have been met.
These tests shall be conducted in the factory or at a
government approved test facility or some combination
thereof. Design Verification testing shall consist of:

     Unit Tests

     Subsystem Tests

     System Tests

     Reliability Tests

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        Subsystem Tests

        System Tests

        Reliability Tests

the test.   During the last half-hour of the test, a
simulated power failure test shall be made.   This test
shall be made by interrupting all AC power to the
system for a period of at least 15 seconds.   When power
is restored, all malfunctions or errors shall be
recorded.   The test shall be resumed without any
equipment adjustments.   If manual adjustments or
intervention is required to re-initiate operation,
these shall be fully documented in the test report.
The contractor shall include in his draft plan the
proposed past/fail criteria to be used in his
recommendation on the length of time the test should
run (minimum of 72 hours is required).

4.1.4 Reliability Demonstration Testing - The
contractor shall perform a reliability demonstration
test on ail units not previously tested to MIL-STD-781.
The test shall be performed using the reliability
criteria defined in Section 3 as the basic
accept/reject criteria.   The reliability demonstration
shall be performed in accordance with Test Plan XXV of
MIL-STD-781.   Preventive maintenance tasks, where
required to be accomplished during the reliability
demonstration, shall meet the requirements of Setion 3
and Paragrph 4.1.5.   These test results shall be used
to calculate the dual RT and BTL system reliability
performances.

4.1.5 Maintainability Tests

4.1.5.1 Corrective Maintenance Demonstration Tasks -
The contractor shall develop corrective maintenance
demonstration plans in accordance with MIL-STD-471,
except as modified herein.   The task selections shall
be outlined in Appendix A of MIL-STD-471.   The
statistical corrective maintenance demonstration tasks
, shall have failure modes based on information from the
Failure Modes and Effects Analysis from Section 3 of
this specification.   Method 1, Plan Al of MIL-STD-471
shall be employed by the contractor for corrective
maintenance tasks in accordance with the procedure
outlined in Appendix A of MIL-STD-471.   The Government
will randomly select 50 of these tasks for the
statistical corrective maintenance demonstration.   The
mean corrective maintenance downtime shall be less than

the test. During the last half-hour of the test, a simulated power failure test shall be made. This test shall be made by interrupting all AC power to the system for a period of at least 15 seconds. When power is restored, all malfunctions or errors shall be recorded. The test shall be resumed without any equipment adjustments. If manual adjustments or intervention is required to re-initiate operation, these shall be fully documented in the test report. The contractor shall include in his draft plan the proposed past/fail criteria to be used in his recommendation on the length of time the test should run (minimum of 72 hours is required).

4.1.4 Reliability Demonstration Testing - The contractor shall perform a reliability demonstration test on ail units not previously tested to MIL-STD-781. The test shall be performed using the reliability criteria defined in Section 3 as the basic accept/reject criteria. The reliability demonstration shall be performed in accordance with Test Plan XXV of MIL-STD-781. Preventive maintenance tasks, where required to be accomplished during the reliability demonstration, shall meet the requirements of Setion 3 and Paragrph 4.1.5. These test results shall be used to calculate the dual RT and BTL system reliability performances.

4.1.5 Maintainability Tests

4.1.5.1 Corrective Maintenance Demonstration Tasks - The contractor shall develop corrective maintenance demonstration plans in accordance with MIL-STD-471, except as modified herein. The task selections shall be outlined in Appendix A of MIL-STD-471. The statistical corrective maintenance demonstration tasks , shall have failure mode; based on information from the Failure Modes and Effects Analysis from Section 3 of this specification. Method 1, Plan Al of MIL-STD-471 shall be employed by the contractor for corrective maintenance tasks in accordance with the procedure outlined in Appendix A of MIL-STD-471. The Government will randomly select 50 of these tasks for the statistical corrective maintenance demonstration. The mean corrective maintenance downtime shall be less than

delivery.

4.2.1.1 Factory Inspection - The quality assurance
provisions specified in FAA-G-2100 and MIL-I-45208A
form a part of this specification and shall be complied
with. All inspections and tests at the contractor's
plant shall. be performed by the contractor, and may be
witnessed, and subject to approval by FAA inspectors.
The government reserves the right to waive the
requirements of any portion of the inspections and
tests.

4.2.1.2 Incoming Inspection - The government may elect
to witness incoming inspection of all or any portion of
the components and materials used in construction of
the equipment to determine compliance with the
specifications covering component procurement.

4.2.1.3 Unit Inspection - Each completed unit supplied
as an integral part (or spare unit) of each system
under the contract shall be given a mechanical and
electrical examination. The mechanical examination
shall be used to determine compliance with the
applicable specifications covering fabrication
requirements such as strength and rigidity,
accessibility, type of components and materials, choise
of insulation, layout of chassis, panel, and wiring,
finish and marking. The contractor shall perform an
electrical inspection to determine compliance with the
applicable specificaticns covering electrical
continuity, leakage resistance, power supply voltages
and regulation, signal to noise ratio, pulse and wave
shapes, resolution, and storage characteristics.

Units built, tested, and approved in accordance with
the applicable specifications may be retained
temporarily by the contractor in order to facilitate
testing of associated units. However, such units used
for test purposes shall be given a mechanical and
electrical re-inspection prior to government acceptance
if required by the contracting officer.

4.2.1.4 Subsystem Tests - Prior to integration into a
system, subsystems shall be tested to determine
compliance with the functional requirements of

specification. In particular, each disc subsystem (hardware and relevant operational software) which will be integrated into existing ARTS III BTL systems shall be tested as a subsystem prior to delivery; disc subsystems which will be integrated into RT & BTL systems shall be similarly tested prior to factory operational system tests (see Section 4.2.1.5). In addition, all support software shall be functionally tested and be subject to error correction and retesting in the same manner as operational software.

4.2.1.5 Operational System Tests - Each single and dual RT & BTL system shall be functionally tested with the operational software prior to delivery using real or simulated inputs. Wherever possible, compliance with system performance requirements shall be verified. The tests shall be designed to insure a high degree of confidence in the proper operation of the system when installed at the site. Those items of the system needed for these tests, but which are not new or modified (i.e., not deliverable under the contract) shall be supplied as GFE.

4.2.2 Site Tests - The contractor shall conduct site tests for every system installation. Site tests shall be conducted at the unit, the subsystem and the system level consistent with the installation and cutover plan (see Section 3.11). Each site test shall be designed to meet the following objectives:

1. To verify that the installed unit, subsystem or system meets the performance requirements of this specification.

2. To verify that existing ARTS III functions can be performed with the unit, subsystem or system installed.

3. To provide the required certification procedures to enable the FAA to operate with the installed unit subsystem or system.

These tests shall be conducted in three stages in accordance with the government-approved installation plan:

1. Stage **1** - Stage one shall verify system integrity **pricr** to interfacing with any site equipment. Stage one must be **successfully** completed before Stage two can be started.

2. Stage 2 - Stage two shall be an integrated test to be conducted after the system is integrated with the site facilities. To minimize interference with the normal operations, this test shall be conducted with, the required number of displays in a test bed configuration.

3. Stage 3 - This stage shall use all operational displays to demonstrate complete site adaption. During this test all functions and combinations of functions such as keyboard and trackball data entry tracking, and display processing, shall be exercised to show conformance with each of the systems operating requirements.'

4.3 Test conduct - The contractor shall be responsible for conducting all tests. Whenever testing is scheduled, the contractor **shall** ascertain that all necessary personnel are available, that contractor provided procedures, test scripts, and test data sheets have been distributed and that the test area has been cleared of all equipment. All test personnel shall normally be provided by the contractor. However, the FAA reserves the right to use FAA personnel in lieu of contractor personnel to man any operating position in the equipment configuration under test. 'The contractor shall conduct a test-briefing and debriefing for each test and shall assure that all personnel have been properly instructed in their duties. The contractor shall make any and all additional tests necessary to demonstrate compliance to the required system performance. If, during the course of any **tests,** errors or **malfuncticns occur,** the contractor shall make entries in the appropriate logs. In addition, the contractor shall document each error or malfunction indicating the' type, the procedures taken and the time required to circumvent, and the assignment to the appropriate equipment **cr** software element.

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required to circumvent, and the assignment to the
appropriate equipment cr software element.

document.   He shall notify the FAA promptly of any
problems beyond his jurisdiction.

4.3.1.4 Equipment Module or Subsystem Modification -
The contractor shall be responsible for incorporating
and testing any modifications to the design necessary
to meet specification requirements. Resulting
modificaticns to equipment shall be inccrporated into
each system delivered at no additional cost to the
Government.

4.3.1.5 Documentation Updating - The ccntractor shall
update the system documentation of block diagrams,
electrical and mechanical drawings, installation
drawings, part lists, wire lists, logic flow charts and
diagrams, computer programs and flow charts, and all
associated descriptive materials. The updating shall
be accomplished periodically to maintain the above
described documentation in current status. Updated
drawings shall be prepared in accordance with the
drawing standards specified in Graphic Symbols for
Digital Diagrams (FAA-STD-010). All copies of obsolete
and voided documents shall be so marked and disposition
shall be made in accordance with FAA instructions.

5.   PREPARATION FOR SHIPMENT - All equipment and spares
shall be prepared for shipment and shipped in
accordance with MIL- E -17555 Method 3 unless air ride
padded shipment is used. Shipment shall be in
accordance with the contract requirements..

* * * * * * * *

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DPS	Data Processing Subsystem
ESR	Executive Service Request
FDB	Full Data Block
FP	Flight Plan
GFE	Government Furnished Equipment
HZ	Hertz'
ICA	Interfacility Communication Adapter
ID	Identification
IMT	Integral Magnetic Tape
I/O	Input/Output
IOP	Input Output Processor
LDB	Limited Data Block
MHz	Mega Hertz
MM'	Memory Module
MSP	Medium speed Printer
MSS	Mass Storage Subsystem
MTI	Moving Target Indicator
MTTR	Mean-Time-to-Repair
NDRO	Non Destructive Read Out
NM	Nautical Mile
NSP	Non Standard Part
PFA	Probability of False Alarm
PN	Probability of Noise

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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
SPECIFICATION

ARTS **IIIA** IMPROVEMENTS TO THE **MODULARLY** EXPANDABLE

ARTS III BEACON TRACKING LEVEL SYSTEM